Annual Report on
Agricultural experiments
and Demonstrations in
Assam
1912-13 to 1914-15

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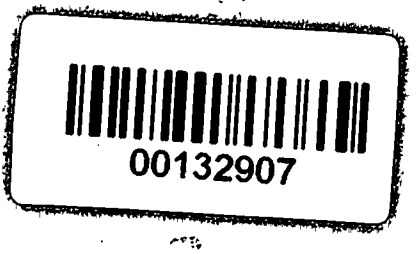
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ANNUAL REPORT

ON THE

AGRICULTURAL EXPERIMENTS AND DEMONSTRATIONS

IN

ASSAM

FOR THE

YEAR ENDING THE 30TH JUNE 1913.

SHILLONG:

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PREFACE.

Mr. A. A. Meggitt, Agricultural Chemist, Dacca, made all the sugarcane analyses and compiled Tables I to VII. I am also indebted to him for the paragraph on "Soil Investigations." A note by Mr. Meggitt on soil acidity and the use of lime is printed as an appendix.

A. G. BIRT,
Deputy Director of Agriculture,
Assam.

15*th September* 1913.

ANNUAL REPORT OF THE JORHAT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING JUNE 30TH, 1913.

Introduction.

This station was established in the beginning of the year 1906 and is intended principally for sugarcane work. It is situated about 3 miles south of Jorhat town in Sibsagar district, Assam Valley. The original area was about 35½ acres, of which 1·7 acres is *hola* or ravine land, and the remainder high land which was under grass and scrub jungle at the time of acquisition. An additional area of 20 acres, mostly high land, was acquired last year; this is gradually being brought under cultivation.

Soil.

2. The soil of the high land is a reddish sandy loam of the old alluvium, lying on a hard greyish yellow subsoil. Where the conditions have not been improved by cultivation, the soil is extremely shallow, varying from only 3 to 6 inches in depth.

The following report by Mr. A. A. Meggitt, Agricultural Chemist, Dacca, is given *in toto* :—

Report on Analysis of Jorhat Farm Soil.

Chemical.	Surface soil.	Sub-soil.
	Laboratory No. 5.	Laboratory No. 5(*a*).
1	2	3
Soluble in hydrochloric acid with 12 *hours' digestion at* 100°*C.*	Per cent.	Per cent.
Phosphoric acid (P_2O_5)	0·025	0·020
Potash (K^2O)	0·115	0·135
Lime (CaO)	0·154	0·144
Magnesia (MgO)	0·166	0·148
Soluble in 1 *per cent. citric acid with* 7 *days' digestion.*		
Phosphoric acid	0·003	0·003
Potash	0·007	0·011
Loss on ignition (organic matter and combined water)	3·26	1·84
Nitrogen	0·114	0·051
Calcium carbonate	0·018	0·018
Re-action	Acid	Acid

Physical constants.

	Hygroscopic capacity.	Maximum water-saturation capacity.		Minimum water-saturation capacity.		Moisture in air dry soil.
		Per cent. of water in saturated soil by weight.	Per cent. of water in saturated soil by volume.	Per cent. of water by weight.	Per cent. of water by volume.	
1	2	3	4	5	6	7
Surface soil	3·10	31·9	50·5	11·2	13·9	1·3
Sub-soil	...	30·0	59·0	7·2	9·1	1·19

Remarks.

" These analyses agree quite well generally with some others made some years ago by the Imperial Agricultural Chemist.

These samples are acid in re-action, and the total lime present in all combinations, as well as the carbonate of lime, is quite deficient in quantity.

Carbonate of lime has an enormous influence on a soil's welfare—chemically, physically, and bacteriologically.

Its effect on soil biological processes are in the right direction, and very great; it also influences the texture of soils in a remarkable way, and is active in bringing into use the reserves of dormant plant food. Its presence in fair amount also ensures the most economical effect of any manuring given. Its absence forbids the use, for most cropping, of certain kinds of manures, unless it be first resorted to.

"Any upland soil containing such small amounts of total lime and lime carbonate as are here present will most certainly respond markedly in the case of most cropping to applications of lime.

"The amount of organic matter is probably greater than obtains in many Indian soils, but there is no doubt that a light soil of this character will be much improved in many ways by an increase in the amount of humus. A good deal of the organic matter present is of a doubtful character, and consists very probably of very old residues of little value; it is the presence and active decay of comparatively recent additions of organic matter which puts life into a soil.

The percentage of nitrogen present in the surface soil is what would normally be considered a fair one, but in view of the absence in anything like adequate quantity of carbonate of lime, conditions for nitrification are probably not as favourable as they might be by a long way, and an increase in the amount of nitrogen is indicated as desirable.

Of potash there is no dearth, and there would seem to be no immediate need for potash manuring.

Regarding phosphoric acid, these samples show a deficiency both in total as well as available supplies. There is thus a 'real' as opposed to a mere temporary lack in respect of this element of plant food.

This lack of phosphoric acid is further aggravated by the absence of sufficiently large amounts of lime carbonate and humus, high percentages of which may, and often do offset a smaller percentage of phosphoric acid.

An acid condition of soil, besides being harmful in itself, very often brings about a more rapid depletion of the soil's stock of phosphoric acid, in consequence of which most soils of a decidedly acid character are found to be lacking in this element, and to respond to its suitable application.

Turning to the physical constants, the hygroscopic capacity is low, and about what one would expect for this class of soil. It means that only water which is in excess of about 3 per cent. is available for crops, and plants are able to reduce the soil moisture content to somewhere about this figure before they begin to wilt. The top 6 inches of soil even during the cold weather normally contains a good deal more moisture than 3 per cent., when under a close standing crop, so that usually there is sufficient water for the crops' requirements."

"As regards maximum saturation capacity, these soils agree quite well with quoted figures for similar soils in Europe, and suggest that the optimum proportion of water for the growth of the plant is about 13·16 per cent. A recent determination of soil moisture in the surface 6 inches of the soil of this farm in August some few hours after rain gave 17 per cent. water. Soil moisture conditions are therefore probably extremely favourable for growth during the rainy season.

The figures for minimum saturation capacity are much lower than those cited (*Hall, The Soil, page* 69) for similar soils in Europe, and this is probably due to the lower content of humus which obtains in our soils. This is an extremely important figure in gauging a soil's power to retain a reserve of moisture for crops during dry periods.

The sub-soil is worse in this respect than the surface layer, suggesting that the incorporation of organic matter, if it can be buried sufficiently deep, will have a very great ameliorating effect indeed.

The sub-soil is capable of very great improvement indeed, as the figures show, but it would probably be immediately disastrous to work it so deeply as to bring any considerable amount to the surface at once.

The growth of deep-rooting legumes as green crops will assist materially, but if the sub-soil could be stirred occasionally while at the same time the surface cultivation is gradually deepened so that green crops may be more deeply buried, a greater depth of surface soil will result, which on this farm is very much to be desired.

I am convinced that for cane cultivation, until the surface soil has been deepened and the amount of humus increased, it is of little use attempting manurial experiments on cane with artificial manures. No amount or combination of the latter can ever make up in the case of a crop like sugarcane for loss of fertility due to shallow cultivation and lack of humus."

Buildings and machinery, etc.

3. The farm is equipped with a godown, combined office and rest-house, quarters for Farm Superintendent and two apprentices and a cattle shed with brick walls and a corrugated-iron roof. A three-roller cane mill 12 inches × 18 inches driven by a 9 B. H. P. Hornsby oil engine was installed in 1911. During the year quarters for the Fieldman clerk were built at a cost of Rs. 600.

4. The rainfall recorded during the growth of the crops referred to is given in the following table together with the normal rainfall:—

Rainfall.

Month.	Actual rainfall, in inches.	Normal rainfall, in inches
1	2	3
1912, April	10·67	8·54
„ May	12·26	9·26
„ June	9·51	11·36
„ July	27·43	14·76
„ August	10·66	15·15
„ September	6·03	9·18
„ October	5·85	4·07
„ November	1·19	0·69
„ December	0·24	0·52
1913, January	0·80	0·93
„ February	4·11	1·32
„ March	2·62	3·90
Total	91·37	79·68
„ April	22·47	8·54

The rainfall was ample and well distributed. The rain in February interfered somewhat with the harvesting of the ratoon cane.

Experimental work.

5. The work of previous years was continued and extended.

It mainly consisted of :—

I. Sugarcane experiments.

II. Soil improvement investigations.

III. Trials of crops new to the locality.

Varieties : ratoon cane.

6. The following varieties planted in Block B in 1911 were ratooned :—

Striped Mauritius	¼ acre plots.
B 147.	
B 376.	
B 1753.	
B 208.	1/10 acre plots.
Striped Tana	
Yellow Tana.	
Magh.	
Kheri.	

The results of the first crop were given in last year's annual report. After harvesting the 1912 crop the trash remaining on the field was burnt and all pieces of diseased cane which remained were collected and removed. The land was then hoed. As in previous years the crop was earthed twice, and received a dressing of 20 maunds of rape cake per acre, half of which was applied at the time of first earthing and half at the second earthing.

Beyond the occasional removal of dead leaves and badly diseased canes no other cultivation was given.

The local variety Magh, as usual, ratooned so badly that the plot was not worth crushing. The results of the remaining varieties are set out in Tables I and II. Table I shews the analyses of the juice and Table II the weights of cane, juice, and sugar, etc., per acre.

TABLE I.

RATOON, 1912-1913.

Juice.

Serial No.	Variety.	Area weighed and analysed.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity co-efficient.	Remarks.
1	2	3	4	5	6	7	8	9	10
			Per cent.	Per cent.	Per cent.		Per cent.		
1	Striped Mauritius	¼ acre...	16·39	0·51	16·90	3·11	17·67	92·7	High purity juices of very good quality.
2	B 376 ...	¼ „ ...	15·32	0·61	15·93	3·98	16·75	91·4	
3	B 208 ...	1/16 „ ...	15·49	0·84	16·33	5·42	17·08	90·7	
4	B 147 ...	¼ „ ...	16·40	0·53	16·93	3·23	17·93	91·4	
5	Yellow Tana ...	1/20 „ ...	13·83	1·26	15·09	9·11	16·50	83·8	
6	Striped „ ...	1/20 „ ...	12·84	1·59	14·43	12·39	15·70	81·8	
7	B 1753 ...	⅛ „ ...	9·67	1·97	11·64	20·37	12·76	75·18	
8	Kheri ...	1/16 „ ...	11·29	1·88	13·17	16·65	14·64	77·1	

TABLE II.

RATOON, 1912-1913.

(*Figures are per acre.*)

Serial No.	Variety.	Area weighed.	Yield of cane per acre.	Yield of juice per acre.	Percentage juice on cane.	Total sugar per cent. on juice.	Total sugar per acre in juice.	Total cane sugar in juice (Sucrose.)	Remarks.
1	2	3	4	5	6	7	8	9	10
			Lbs.	Lbs.			Lbs.	Lbs.	
1	Striped Mauritius	¼ acre	55,907	36,920	66·0	16·90	6,240	6,051	Badly diseased and lodged.
2	B 376	¼ „ ...	61,336	43,140	67·5	15·93	6,600	6,347	Badly lodged, not diseased.
3	B 208	1/16 „ ...	72,160	47,090	65·2	16·33	7,690	7,294	Badly lodged, some borer and disease present.
4	B 147	¼ „ ...	69,120	47,016	68·0	16·93	7,960	7,710	Excellent cane, topped for sets, reducing yield slightly.
5	Yellow Tana ...	1/20 „ ...	72,360	45,120	62·3	15·09	6,809	6,240	A finer variety than the Striped Tana.
6	Striped „ ...	1/20 „ ...	74,784	46,900	62·7	14·43	6,767	6,022	Coarse fibrous cane; gives much trouble at the mill.
7	B 1753 ...	⅛ „ ...	55,609	35,088	63·1	11·64	4,084	3,570	Badly diseased.
8	Kheri ...	1/16 „ ...	82,600	48,180	58·3	13·17	6,346	5,440	

This year all the varieties, with the exception of Striped Mauritius and Kheri, gave less percentage of total sugar in juice than last year. With regard to total sugar per acre, B 147, B 208, Kheri and the Tanas shew a very considerable increase over last year's figures; B 376, owing chiefly to lodging, gives over 2,000 lbs. less total sugar than last year, and B 1753 is also down on last year's figures, although not to the same extent, while Striped Mauritius is about the same as last year.

The four varieties B 147, B 208, B 376 and Striped Mauritius give juices of much higher purity than any of the other varieties. B 147, with a juice purity co-efficient of 91·4 and a yield of nearly lbs. 8,000 of total sugar per acre, gives the best results this year, closely followed by B 208, a variety which some years ago we very nearly decided to drop altogether, as it was doing so badly. B 1753 is the worst of all both with regard to quality of juice and yield of total sugar per acre. This variety has been going from bad to worse during the last few years, and in view of the fact that it was impossible to get sufficient sound cuttings to plant even a small area, we decided last year to exclude it from future experiments.

Varieties: plant cane.

7. The following varieties were grown on Block A:—

B 147.
B 376.
Striped Mauritius. } ¼ acre duplicate plots.

B 208.
Yellow Tana.
Magh.
Kheri. } $\frac{1}{20}$ acre plots.

B 1753 was excluded for the reasons stated in paragraph 6. Striped Tana was also excluded as being similar to the yellow variety but inferior as regards quality of juice, and at the same time being so thick and coarse that milling was difficult.

This block of land carried a crop of cane in 1908-09 which was ratooned on part of the area in 1909-10. The land was in wretched condition at this time, in fact the worst land on the farm. A dressing of 50 maunds of slaked lime was applied in 1910 after the removal of the ratoon crop, which was followed by *aus* paddy. The following cold weather it carried a poor crop of *matikalai*. In 1911 it was green manured with cowpeas and left fallow during the cold weather of 1911-12.

Owing to the poor results obtained with cane on this block before, it was with grave misgivings that we decided to plant cane again in 1912, but we had no choice since there was no other land available at the time.

In order to give the crop the best possible chance, the trenches were opened out at the end of January about two months before planting the cane, instead of just before planting as in former years, and the sub soil at the bottom of the trenches was turned over to a depth of about 6 inches. Subsequently the haulms of a crop of groundnuts, which had recently been harvested, were thrown into the trenches and incorporated with the sub-soil. The sub-soil in the trenches was thus exposed to weathering for about two months, and in addition had a considerable amount of organic matter added. Another innovation was tried in the case of manuring. Instead of ploughing in 500 maunds of cowdung before planting as was the practice hitherto, 200 maunds of the cowdung was applied in the trenches at planting time, and the remainder was given in two doses, one at the time of first earthing and the other at the second earthing. Subsequent cultivation was as usual, consisting of stripping and removal of badly diseased canes periodically. As will be readily gathered from the following tables, the results obtained fully justified the new methods of cultivation, the crop being far ahead of anything hitherto obtained on the farm.

TABLE III.

Plant Cane, 1912-1913.

Juice.

Variety.	Area weighed and analysed.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity coefficient.	Remarks.
1	2	3	4	5	6	7	8	9
		Per cent.	Per cent.	Per cent.			Per cent.	
B 147 (plot 1) ...	½ acre	16·85	0·52	17·37	3·08	18·43	91·4	Plot 1 was laid by storm and had to be harvested before it was ripe.
B 147 (plot 4) ...	½ „ ...	17·37	0·3	17·67	1·72	18·7	92·9	
B 376 (plot 2) ...	½ „ ...	16·82	0·36	17·18	2·14	17·9	93·97	
B 376 (plot 5) ...	½ „ ...	15·08	0·45	15·53	2·98	16·3	92·5	Plot 5 was badly laid by otetrs and very much damaged by parrots and became overripe befor it could be crushed on account of bad weather.

TABLE III—*concld.*

Variety.	Area weighed and analysed.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity coefficient.	Remarks.
1	2	3	4	5	6	7	8	9
		Per cent.	Per cent.	Per cent.			Per cent.	
* Striped Mauritius (plot 3).	¼ acre	16·84	0·39	17·23	2·31	17·85	94·3	
B 208	1/20 „ ...	18·97	0·20	19·17	1·05	19·70	96·3	Great improvement in this cane.
Yellow Tana	1/20 „ ...	15·65	0·59	16·24	3·77	17·65	88·6	
Magh	1/20 „ ...	13·23	0·90	14·13	6·80	15·4	85·9	
Kheri	1/20 „ ...	13·23	1·23	14·46	9·30	15·75	84·0	

* Results of only one plot are given, as there were not sufficient sets to plant a full duplicate plot, and the land was inferior in that part of the field.

TABLE IV.

Plant Cane, 1912-1913.

Variety.	Area weighed and analysed.	Yield of cane per acre.	Yield of juice per acre. lb.	Per cent. juice on cane.	Total sugar per cent. on juice.	Total sugar per acre in juice.	(Sucrose.) Total cane sugar per acre in juice.	Remarks.
1	2	3	4	5	6	7	8	9
		Lbs.	Lbs.			Lbs.	Lbs.	
B 147 (plot 1) ...	¼ acre.	74,736	51,376	68·7	17·37	8,924	8,656	Topped for sets. Excellent cane.
B 147 (plot 4) ...	¼ „	70,232	47,096	67·0	17·67	8,322	8,180	Ditto ditto.
B 376 (plot 2) ...	¼ „	72,856	49,568	68·0	17·18	8,515	8,337	Ditto ditto.
B 376 (plot 5) ...	¼ „	68,712	46,884	68·2	15·53	7,282	7,070	Badly damaged by storms and parrots.
Striped Mauritius (plot 3)	¼ „	70,968	49,328	69·5	17·23	8,500	8,307	Excellent cane. Much better than for past few years.
B 208	1/20 „	58,520	38,160	65·2	19·17	7,315	7,240	Better cane than usual. This variety is undoubtedly improving.
Yellow Tana	1/20 „	62,160	39,600	63·7	16·24	6,431	6,197	
Magh	1/20 „	62,320	42,160	67·6	14·13	5,957	5,577	
Kheri	1/20 „	75,300	45,940	61·0	14·46	6,643	6,078	

The great feature of this year's results is the very high yields of cane and sugar per acre of the four varieties B 147, B 376, B 208 and Striped Mauritius. Kheri also gives a big yield of cane, but owing to the low percentage of juice on cane and the inferiority of its juice, the yield of sugar per acre is very much less.

B 147 (plot 1) gave practically 4 tons total sugar per acre in extracted juice, and 3·86 tons sucrose. This is the highest yield we have ever had, and would probably have been greater had not the crop been heavily laid by a severe storm before it was ripe, necessitating premature harvesting. The plot was topped for sets, this also reducing the yield slightly.

The average yield of sucrose per acre for the four varieties B 147, B 376, B 208 and Striped Mauritius works out at just over 3·5 tons per acre.

The juice of all these varieties is rich in sucrose, poor in glucose, and of very high purity.

The excellent results obtained this year are probably due to a very large extent to—

(*a*) improved drainage;

(*b*) weathering of sub-soil in trenches;

(*c*) direct application of manure to the crop;

(*d*) comparative freedom from borer, probably due to the fact that, for the last two years, the trash from both plant and ratoon cane has been spread over the fields and burnt.

Planting experiments: Ratoon cane.

8. This was laid down in Block B in 1911 on four $\frac{1}{10}$ acre plots, the following methods of planting being compared:—

Plot I—Rows 3′ apart, sets planted 2′ apart in row.

„ *II*— Ditto sets planted end to end.

„ *III*—Rows 4′ apart, ditto ditto.

„ *IV*— Ditto and 1′ wide, sets planted alternately.

The results of the first crop are given in last year's report. The ratoon crop was treated in the same way as in the variety experiments. The results are given in the following table:—

TABLE V.

RATOON, 1912-1913—PLANTING EXPERIMENT.

Striped Mauritius $\frac{1}{10}$th acre plots.

—	Cane per acre.	Juice per acre.	Per cent. juice on cane.	Cane sugar in juice.	Invert sugar in juice.	Total sugar in juice.	Glucose ratio.	Total solids on juice.	Purity coefficient.	Total sugar per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
	Lbs.	Lbs.		Per cent.	Per cent.	Per cent.		Per cent.		Lbs.	
Plot 1 ...	65,340	40,570	62·1	15·01	0·92	15·93	6·13	16·54	90·7	6,463	All badly diseased.
„ 2 ...	60,800	37,260	61·3	15·00	0·92	15·92	6·13	16·71	89·7	5,932	
„ 3 ...	56,320	38,390	68·1	15·12	0·83	15·95	5·49	16·68	90·6	6,123	
„ 4 ...	62,600	40,820	65·2	15·19	0·84	16·03	5·53	17·05	89·1	6,543	

All the plots were badly diseased and this seriously detracts from the value of the experiment. There is very little to choose between any of the plots. The increased number of sets in plots 2, 3 and 4 give no advantage over the usual number (7,260 per acre) in plot I.

Planting experiment: Plant cane.

9. This was laid down in 1912 in Block A. Cultivation and manuring was the same as for the variety experiments in the same block. There were three plots each $\frac{1}{8}$ acre in area, the distance between the rows being 3, 4 and 5 feet, respectively. An equal number of sets was planted in each row. The variety planted was B 376. The results are set out in Tables VI and VII.

TABLE VI.

Plant cane, Planting Experiment, 1912-13.

B 376.	Area plot.	No. of rows.	Width apart of rows.	Sets per row.	Weight of cane produced per row.	Number of canes produced per row.	Remarks.
1	2	3	4	5	6	7	8
Plot 1 ...	⅛ acre	20	3 ft.	45	Lbs. 469	117	Each row had same number of sets. The distance between the rows, and hence the number of rows per plot was the only variant.
„ 2 ...	⅛ „	15	4 ft.	45	544	130	
„ 3 ...	⅛ „	12	5 ft.	45	598	145	

TABLE VII.

Plant cane, Planting Experiment, 1912-13.

B 376.	Cane per acre.	Juice per acre.	Juice on cane.	Cane sugar in juice.	Invert sugar in juice.	Total sugar in juice.	Glucose ratio.	Total solids in juice.	Purity co-efficient.	Total sugar.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
	Lbs.	Lbs.	Per cent.	Per cent.	per cent.	Per cent.		Per cent.		per acre.	Same number of sets in each row in all three plots.
Plot 1 (⅛ acre) ... 20 rows 3 ft. apart ...	75,024	49,176	65·5	16·51	0·35	16·86	2·12	17·55	94·0	8,290	Plot 1 had some 7,200 sets per acre.
Plot 2 (⅛ acre) ... 15 rows 4 ft. apart ...	65,304	43,472	66·5	16·59	0·31	16·90	1·87	17·60	94·2	7,347	Plot 2 had some 5,400.
Plot 3 (⅛ acre) ... 12 rows 5 ft. apart ...	57,400	40,176	69·9	16·25	0·32	16·57	1·97	17·25	94·2	6,657	Plot 3 had some 4,320.

As regards quality of juice there is practically no difference between the three plots.

The figures show clearly that, with the same spacing of sets in the rows, the wider the rows are apart the better the tillering and the bigger the weight of cane per row.

However, it appears that though the above is true, yet the number of sets per acre cannot be reduced below about 7 to 8 thousand, *i.e.*, the extra tillering due to wider planting does not fully compensate for the reduction of the number of sets.

Taken in conjunction with last year's plant-cane planting experiment results, it seems very probable that it will be possible to obtain full crops with rows 4 or 5 feet apart provided the sets are so spaced in the row as to give 7 to 8 thousands sets per acre. For cultivation with machinery wider planting than 3 feet apart would be necessary in order to give sufficient space for interculture. Probably from 4 to 5 feet between the rows would be sufficient. The point to be decided is the number of sets required in the wider rows to give the maximum crop.

Sugarcane. General remarks.

10. The chief point to be noticed is the very heavy yields of cane and sugar per acre of B 147, B 376, B 208 and Striped Mauritius. In 1909 and 1910 these varieties, amongst others, were grown on this area (Block A) and the 1st crop (1909) was so poor that it was not thought worth while harvesting experimentally. This was not for want of direct manuring, as the crop received 400 maunds of cowdung and 24 maunds of rape cake per acre. The ratoon crop from this area was harvested in 1910 and the results are given in the Annual Farm Report for that year.

A comparison of the results is instructive. In 1910 Striped Mauritius gave about 4,000lbs., B 147 3,200lbs. and B 376 2,700lbs. of sugar per acre, as against 8,500lbs., 8,900lbs. and 8,500lbs., respectively, in 1913.

In the case of Striped Mauritius and B 147 this year's yield is more than double that of 1910, while for B 376 it is more than treble.

The explanation of this is probably that since the harvesting of the ratoon crop in 1910—

(*a*) the land has been limed,

(*b*) the land has been green-manured,

(*c*) the sub-soil in the trenches was weathered before planting.

Another factor influencing the yield in 1913 is that the sets were very carefully selected for planting and hence disease was reduced to a minimum.

On the whole the results obtained this year, combined with those obtained in former years, indicate that in Assam it is possible to grow heavy crops of sugarcane of very high quality. At Jorhat we are working on a very poor soil with shallow cultivation. If from 3 to 4 tons of sugar per acre can be obtained by our more or less primitive methods on a poor soil, what results should be obtained on a good soil with deeper and more up-to-date methods of cultivation ? This problem we hope to solve within the next three or four years, when it is proposed to grow a large area of cane by steam-tackle cultivation.

Soil Investigation.

11. The soil and manurial work described in last year's report* has been continued, and in some directions amplified and extended.

This work forms part of a general investigation of special soil conditions obtaining in tracts of heavy rainfall, where for various reasons a dangerous degree of soil acidity is fairly general.

Much valuable information has already been obtained as to the special characteristics of these soils, and the measures adopted for their amelioration are proving very promising.

The work is being tackled principally from the point of view of the soil's requirements for lime, organic matter, and phosphoric acid, for general cropping, and involves a study of the principles underlying their most successful and economical use and supply.

Of special importance under our conditions is the form in which certain manures find their most suitable application.

Thus, work during the year has shown that the use of basic insoluble phosphates is generally attended with markedly beneficial results on cropping, while where acid superphosphate is used the effect is very small unless used in conjunction with lime. There is good reason to believe that its continued use without lime can result in nothing but definite injury to the soil.

Again, Sulphate of ammonia proved absolutely toxic to a crop of oats in the cold weather in the absence of previous liming.

General,—Continued observations on the comparative growth of various crops on limed and unlimed areas confirm fully the statements made in last year's report as to their much greater luxuriance on the former.

* Annual Report of the Jorhat Experiment Station, year ending 30th June, 1912.

Four new crops come under observation during the year, *e.g.*, barley, soy-beans; also dhaincha and sunn hemp as green manures.

Barley and soy-beans were sown on both limed and unlimed land; both crops did extremely well on the former, while on the unlimed area the barley early succumbed, the soy-beans ripening off a very small crop only.

Sunn hemp and dhaincha were grown only on limed soil; both made very good crops, sunn hemp being the better. There should be a very useful field for sunn as a green manure crop on the lighter soils of Assam.

Cowpeas for green-manure, and earthnuts were both sown on limed and unlimed areas. In either case they did much better on limed land making more luxuriant crops, darker green in colour, and entirely smothering the weeds.

Again, a catch green manure crop of cowpeas, sown at the end of July after harvesting *aus* paddy, in one of the experimental blocks, made within 7 weeks growth a 10-anna crop on the limed plot, and only a 4-anna one on the unlimed side. Previous to this both plots had been cropped for 3 years without other manure.

The cane crops obtained during the year bear further strong evidence as to the soundness of our soil policy, which in addition to the direct manuring of the cane, include the use of lime and the regular inclusion of green-manuring in the rotation, coupled with good cultivation.

The average yields of cane for our three best varieties, each grown on duplicate ¼ acre plots, was 31·9 tons per acre, being just about three times the crop obtained in 1908-09, the last year that the self same area came under cane, when it was by the way directly manured much more heavily than during the year under report.

The gradual increase in crop production is being attended by steadily improving soil conditions, rather than by a process of gradual soil impoverishment, and this is as it should be of course.

Experimental—Block G.—This experiment commenced in 1909, and described on pages 19-21 of last year's report was continued, this being its 4th year. It was cropped as for last year, *viz.*, *aus* paddy followed by *matikalai*, oats, gram and mustard in the cold weather.

A catch crop of cowpeas for green-manure taken after the *aus* paddy, on the limed side made a 10-anna crop, only a 4-anna crop resulting on the unlimed area.

No manure was applied to either side. During the cold weather, as in former years, of the four crops sown, none survived the seedling stage on the unlimed side.

On the limed area with the exception of mustard, the other crops, *e.g.*, *matikalai*, oats, gram, were not so good as in the previous years. Oats made a medium crop, *matikalai* a poor one, while the gram, starting well, gradually succumbed as the cold weather wore on.

This may be due to exhaustion of plant food by four years' continuous cropping without any manure, or to the fact that the supply of lime is becoming exhausted, or both. It received lime at the rate of 50 maunds per acre in 1909; two years later the soil was slightly alkaline to 6 inches, below that it was acid. In 1912, the first three inches only was faintly alkaline, below that depth was acid again.

There is then good evidence that acid conditions are gradually being re-established, and the crop of gram in particular bore striking evidence to that effect, gram being a crop which requires a good deal of lime.

Block C—Experiment.—This experiment, commenced in 1911 and described on pages 23 to 32 of last year's report, was continued in its second year.

The plots which had only 10 maunds lime per acre in 1911, received a second dressing of 10 maunds this year also.

None of the other plots received further lime. Cross-dressings of bone-meal and cowdung were applied as in the first year of the experiment.

The cropping during 1912 was:—

Rains	...	...	*Jowar*, for fodder.
Rabi	...	...	Mustard.

Field observations during growth.

Jowar.—This crop germinated badly, owing to poor seed, all over either block.

On the two non-limed areas the seedlings died out completely at a very early stage, even where cross-dressed with bone-meal, or cowdung, or both.

The outstanding feature throughout the growing period of this crop was the enormous influence of lime, the effect being proportional to the dressing; thus the growth on the 60 maunds lime plots was much better than that on the 30 maunds plots, which was not the case with the preceeding crop of oats.

On the green-manured block the crop throughout was stronger, darker green, and healthier looking than on the non-green-manured area; still, where not limed, there was not a vestige of *jowar*.

The effect of bone-meal was not very marked during the growing period, except on the green manured block when used along with cowdung and the larger lime dressings.

The effect of cowdung was more evident than that of bone-meal, but again was most marked where applied with the larger lime doses.

It is to be noted that even within the limits of the same sub-plot, there occurred in some cases a wide variation in the crop, unhealthy looking patches of smaller plants here and there proclaiming apparently a greater degree of toxicity than in the surrounding soil.

Mustard.—With this crop also the seedlings, after germinating well, early died out on the unlimed plots, with the exception of a few plants on one sub-plot, the disposition of these survivors suggesting that lime had carried over from a neighbouring limed plot.

The lime dressings alone, in the absence of other manuring, gave extremely poor crops, which were not much increased where cross-dressed with cowdung. The larger lime dressings appeared to be little, if any, more effective than the smallest one.

The crop only became of any importance where bone-meal was used along with lime, and in this case the superaddition of cowdung produced a very marked effect indeed.

The general appearance of the green-manured block during growth was not better than that of the non-green-manured. As the block has only been green-manured once, and as this forms the third crop taken since that time, two of which (oats and *jowar*) made much bigger crops on the green-manured block, this result is perhaps not very surprising, especially when one recalls the fact that *jowar* is a very exhausting crop.

The requirements of this soil for mustard would appear to be met by a small lime dressing and bone-meal and cowdung.

Without lime, the other manures were without effect. With lime, phosphate is the second necessary addition, and cowdung comes third if a really good crop is to result.

The above observations were generally confirmed by the final results as may be gathered from the appended table (Table VIII).

TABLE VIII.

Block C.

Jowar *and Mustard*, 1912-1913—*2nd year of experiment.*

Cross dressings.	Non-green-manured block.				Green-manured block.			
	No lime.	Lime 20 mds. = (10 + 10).	Lime 30 mds.	Lime 60 mds.	No lime.	Lime 20 mds. = (10+10).	Lime 30 mds.	Lime 60 mds.
1	2	3	4	5	6	7	8	9
	Mds. sr.	Mds. sr.	Mds. sr.	Mds. sr.	Mds. sr.	Mds. sr.	Mds. sr.	Mds. sr.
Nil	J.= 0 0	J.= 63 30	J.= 84 20	J.= 122 20	J.= 0 0	J.= 48 20	J.= 115 0	J.= 150 0
	M.= 0 0	M.= 0 20	M.= 0 20	M.= 0 27½	M.= 0 0	M.= 0 10	M.= 0 7½	M.= 1 2½
Bone-meal 3 mds. per acre in 1st and 2nd year.	J.= 0 0	J.= 87 0	J.= 81 20	J.= 120 0	J.= 0 0	J.= 41 0	J.= 122 10	J.= 162 20
	M.= 0 0	M.= 6 0	M.= 4 30	M.= 3 37½	M.= 0 2½	M.= 3 32½	M.= 4 30	M.= 6 2½
Bone-meal 3 mds., cowdung 100 mds. in 1st and 2nd year.	J.= 0 0	J.= 66 0	J.= 87 20	J.= 163 20	J.= 0 0	J.= 73 20	J.= 220 0	J.= 209 20
	M.= 0 0	M.= 8 0	M.= 8 15	M.= 8 10	M.= 1 5*	M.= 6 12½	M.= 6 20	M.= 7 22½
Cowdung 100 mds. per acre in 1st and 2nd year.	J.= 0 0	J.= 91 0	J.= 129 20	J.= 221 20	J.= 0 0	J.= 80 0	J.= 167 0	J.= 191 0
	M.= 0 0	M.= 2 10	M.= 2 0	M.= 3 10	M.= 0 2½	M.= 0 35	M.= 0 32½	M.= 3 10

Yields are per acre—
J.= Green *jowar*.
M.= Mustard grain.

* There appears to have been some small transference of lime into this sub-plot from the neighbouring 60 mds. lime plot.

Financial aspect.—A clearer and fairer idea of the behaviour of the two experimental blocks (green-manured and non-green-manured) under the differential manuring, will be obtained from a perusal of Table IX, wherein is set forth the total value of the cropping per acre for each sub-plot for the three crops oats, *jowar*, and mustard, together with the cost of manuring of each sub-plot, and the profit (P) or loss (L) resulting on the above crops.

For the immediate purposes of this table, the value of the straw of the oats and mustard crops has not been included.

Its inclusion would, of course, tend to send up the profits somewhat, or diminish the losses, as the case may be.

To the enquiring mind, the figures as they stand will readily reveal where the real value of the experiment lies.

In almost every sub-plot the value of the cropping (V) is greater on the green-manured block than on the corresponding sub-plot in the other block; this is especially noticeable on those plots receiving the heavier lime dressings of 30 and 60 maunds per acre, respectively, in which cases the average value of the cropping is almost exactly 33 per cent. greater than on the corresponding plots in the non-green-manured block.

Even though the value of the *aus* paddy crop which was grown on the non-green-manured block, while the other was under cowpeas for green-manure, be reckoned to its credit, the position remains much the same. In this case the average value, per sub-plot, of the cropping on the 30 and 60 maunds limed areas of the green-manured block, is some 20 per cent. greater than that of the corresponding sub-plots of the other block, while the average value of corresponding sub-plots of both blocks receiving only 20 maunds lime per acre is almost identical.

This is a very strong argument in favour of the practice of green-manuring where lime applications which are at all heavy are being used.

The figures show the very great value of lime on these soils for mixed cropping, but they prove a good deal more than that; they prove that not only is it advantageous to green-manure when liming, but also that if the best results are to follow, other manuring must not be neglected, indeed that it will pay to treat the land liberally in other directions.

Thus, with lime costing us Re. 1-13-0 per maund on the Farm, the table shows that even where 60 maunds lime was applied along with bone-meal and cowdung (the total cost of the manuring per acre for the two years amounting to the very high sum of Rs. 139-14-0), the two years' cropping has resulted in a small profit of Rs. 11 on the green-manured block. Again 30 maunds lime on the green-manured block, used with cowdung or with bones plus cowdung, has returned within 2 years, with the cropping given, a profit of some 60 per cent. on outlay in either case.

TABLE IX.

Block C.

Cross dressings.	Non-green-manured blocks.				Green-manured blocks.			
	No lime.	Lime 20 maunds = (10 + 10).	Lime 30 maunds.	Lime 60 maunds.	No lime.	Lime 20 maunds = (10 + 10).	Lime 30 maunds.	Lime 60 maunds.
1	2	3	4	5	6	7	8	9
	Rs. a.	Rs. a.	Rs. a.	Rs. a.	Rs. a.	Rs. a.	Rs. a.	Rs. a.
Nil	V.= 0 0 C.= 0 0	V.= 39 11 C.= 34 6 P.= 5 5	V.= 59 14 C.= 51 9 P.= 8 5	V.= 65 6 C.= 103 2 L.= 37 12	V.= 0 0 C.= 0 0	V.= 39 9 C.= 34 6 P.= 5 3	V.= 70 11 C.= 51 9 P.= 19 2	V.= 80 6 C.= 103 2 L.= 22 12
Bone-meal 3 maunds per acre in 1st and 2nd year.	V.= 0 0 C.= 0 0	V.= 58 0 C.= 52 6 P.= 5 10	V.= 77 7 C.= 69 9 P.= 7 14	V.= 81 0 C.= 121 2 L.= 40 2	V.= 0 5 C.= 18 6 L.= 17 11	V.= 56 14 C.= 52 6 P.= 4 8	V.= 103 6 C.= 69 9 P.= 33 13	V.= 107 5 C.= 121 2 L.= 13 13
Bone-meal 3 maunds, cowdung 100 maunds in 1st and 2nd year.	V.= 6 0 C.= 36 12 L.= 30 12	V.= 82 8 C.= 71 2 P.= 11 6	V.= 102 14 C.= 88 5 P.= 14 9	V.= 117 14 C.= 139 14 L.= 22 0	V.= 5 5 C.= 26 12 L.= 21 7	V.= 97 2 C.= 71 2 P.= 26 0	V.= 142 14 C.= 88 5 P.= 54 9	V.= 151 2 C.= 139 14 P.= 11 4
Cowdung 100 maunds per acre in 1st and 2nd year.	V.= 3 6 C.= 18 12 L.= 15 6	V.= 66 7 C.= 53 2 P.= 13 5	V.= 89 5 C.= 70 7 P.= 19 0	V.= 109 4 C.= 121 14 L.= 12 10	V.= 9 5 C.= 18 12 L.= 9 7	V.= 74 4 C.= 53 2 P.= 21 2	V.= 112 0 C.= 70 5 P.= 41 11	V.= 134 15 C.= 121 14 P.= 11 1

V.= Value of grain of oats and mustard crop + value of green jowar crop.
C.= Cost of manuring per acre for the different plots for the first two years of the experiment.
All figures are 'per acre.'

P.= Profit on 2 years' working.
L.= Loss ,, ,, ,,

Summary.—On the results of the first two years of the experiment the following tentative conclusions are put forward for mixed cropping on poor sour upland soils in Assam :—

(1) That it will pay to use lime.

(2) That it may be applied with profit up to initial dressings of 30 maunds per acre, especially if used in conjunction with green-manuring and the application of cowdung and phosphates.

(3) That when using lime at all, green-manuring is advisable but becomes absolutely essential when applying anything like a large dressing.

(4) That it will pay to lose an *aus* paddy crop occasionally in order to get in a full green crop.

(5) Certain crops respond better to heavier dressings of lime than others, and demand more of it.

(6) The first demand of the soil is for lime and organic matter containing nitrogen.

(7) In the absence of lime and organic matter, other added manures may either fail altogether, or fail to exert their full value.

The experiment cannot yet, in the nature of the scheme, pronounce any verdict on the relative value of a single larger dose *versus* periodical smaller lime applications, but it would appear that anything larger than an initial dressing of 30 maunds is not advisable in any case.

Wood ashes experiment.—This was continued during the year, the annual dressings of wood ashes and cowdung being applied as usual.

The cropping was *jowar* and oats.

Jowar germinated fairly well all over the plots, lived a sorry life for some three weeks, and died out all over the block.

Evidently although wood ashes has destroyed the toxicity of this soil to oats to some exent, in the quantities applied by us to date it is not sufficiently effective to produce any sort of a crop of *jowar*, even where used with cowdung.

Jowar is particularly sensitive to soil toxins, and it would probably require enormously heavy dressings of wood ashes on our soil to produce a crop.

The oats crop in the cold weather germinated all over the plots.

The seedlings died out very early on the plot receiving no ashes, but struggled for a few weeks longer where the small dressings of 5 and 10 maunds were used.

In the result, small crops of oats were harvested from the 15 and 20 maunds ashes plots, the crop from the latter amounting to some 3½ maunds per acre, a very small yield but still a crop, and a much better crop than the same plot yielded 12 months before.

Block K—Experiment.—This was new field work laid down in the year under review.

It is a comprehensive experiment designed to ascertain if possible to what particular function of lime its observed early remarkably beneficial action on cropping may be due.

Lime might conceivably benefit cropping in a number of ways, *i.e.*, by supplying plant food, by improving the texture and the general biological conditions, or by liberating other plant foods from the soil reserves, etc., but though some of these desirable effects would appear to follow the application of lime very quickly, the results of this experiment go to prove most convincingly that its early beneficial action on cropping is undoubtedly primarily due to its power of neutralising and putting out of court the soil acids (some of which are highly toxic), thus leading to an immediate improvement in the soil's bio-chemical factor. Clearly the correction of acidity forms the very corner stone of any attempt to establish better general soil conditions, for most cultivated crops at any rate, and a knowledge as to the presence or absence of soil acidity becomes of fundamental importance in framing manurial schemes. The experiment showed clearly that in the presence of acidity not only did certain manures, and combinations of manures, have no effect on crop production, but that they did very definite harm in some cases.

With previous liming, using the same manures, the whole position was reversed, resulting in increase of crop.

It is hoped to publish separately, shortly, an account, with the whole of the most interesting results, of this experiment.

During the year under report an experiment was laid down on about 2 acres of the newly acquired area to test the action of different dressings of powdered limestone on this soil. The experiment is divided into two blocks, one of which will be cultivated by the ordinary country implements and the other by an English plough which turns up the soil to a depth of about 9 inches.

Soy-beans.

12. A small quantity of Manchurian soy-beans obtained from Chittagong was sown on both limed (lime applied 2 years previously) and unlimed areas. Date of sowing was the middle of June, and of harvesting the beginning of December. The area of the limed plot was 0·17 acre and that of the non-limed plot 0·11 acre.

The following results were obtained :—

	Per plot grain.		Per acre grain.	
	Mds.	srs.	Mds.	srs.
Limed area	3	8	18	4
Non-limed area	0	17¾	4	1

Potatoes.

13. The following varieties were tried on small plots in the Kitchen garden area. The seed was obtained from the Upper Shillong Farm :—

King of Potatoes	·10 acre.
Magnum Bonum	·07 „
Khasi Nainital	·05 „

The result was as follows :—

	Per plot.		Per acre.	
	Mds.	srs.	Mds.	srs.
King of Potatoes	9	9	92	10
Magnum Bonum	5	26	80	29
Khasi Nainital	2	25	52	20

Groundnut.

14. This crop has now been grown for five years. During the year under report the crop was planted on ¼ acre limed land, and also on about ⅔ acre of unlimed land in Block D. The crop on the limed area was unmanured, while 150 maunds of cowdung per acre was applied to the non-limed area.

The outturn from the limed area was 4 maunds of nuts or 16 maunds per acre, and from the unlimed area 8 maunds 14 seers or about 12½ maunds per acre.

The yield is very much less than last year owing to the destruction of a portion of the crop by rats.

Barley.

15. This crop was tried for the first time at Jorhat on about ⅕ acre of land in the Kitchen garden area. The crop was sown on November 20th and grew well but was heavily laid by a storm before it was ripe. The crop was harvested at the beginning of March. The yield was 2½ maunds, equal to 12½ maunds per acre. The yield would probably have been at least 50 per cent. greater had the crop not been laid, resulting in a large proportion of light grain.

A small area of non-limed land was also sown; but the crop was a complete failure. This result is similar to that invariably obtained with oats on this soil.

16. *Aus* paddy was sown on Block E after the removal of the ratoon sugarcane. This was followed by *matikalai* in the cold weather.

Other crops.

Cowpeas for green-manure was sown over the whole experimental area in Block D, in preparation for sugarcane.

Dhaincha and sunn hemp were grown for trial on small areas of limed land in case it should be necessary to introduce them as green-manure crops at any time. They both grew very well, but the sunn was attacked by caterpillars.

17. The Mozafferpur lichi trees blossomed and set a large quantity of fruit, but high winds destroyed most of it.

Fruit.

Propagation by layering was tried successfully, and the "layers" was distributed to several people in the neighbourhood, the total price realized being Rs. 14.

Ceylon pineapples still continue to do much better than the Barbadoes and Spanish varieties.

Guavas are growing fairly well, but the fruits are small.

The only custard apple tree on the farm produced a few very good fruits this year.

The mangoe trees are stunted and up to the present have borne no fruit.

18. The receipts amounted to Rs. 2,110 (chiefly by sale of sugar), of which Rs. 17 was outstanding at the close of the year. This does not include the value (Rs. 75) of 15,000 sugarcane cuttings distributed free and supplied for demonstration purposes.

Receipts and expenditure.

The total expenditure, including Rs. 1,979 for establishment and Rs. 2,070 for capital charges, was Rs. 10,784.

19. This consists of a Farm Superintendent on Rs. 100—10—200, a Fieldman clerk on Rs. 25—$1\frac{1}{2}$—40 and a peon on Rs. 8. There are also two apprentices under two years' practical training on stipends of Rs. 10 in the first year and Rs. 12 in the second year. Srijut Bina Ram Das held the post of Farm Superintendent throughout the year. Srijut Devi Prasad Gohain was appointed Fieldman clerk from October 23rd on the resignation of his predecessor.

Establishment.

Two new apprentices were appointed during the year, one Bholanath Gogai from October 25th and the other Bhudhar Phukan from November 10th.

20. The Hon'ble the Chief Commissioner, accompanied by the Commissioner of the Assam Valley and the Deputy Commissiner, inspected the farm in August.

Inspection.

The Director of Land Records and Agriculture inspected the farm on two occasions. The Deputy Director visited Jorhat nine times, inspecting the farm several times on each occasion. Mr. A. A. Meggitt accompanied the Deputy Director on three occasions and spent a considerable time on the farm in February, March and April in connection with the sugarcane work.

Other visitors included Dr. J. W. Leather (Imperial Agricultural Chemist), Dr. Butler (Imperial Mycologist), Dr. Hope (Chief Scientific Officer, Tea Association), the Hon'ble Mr. Forbes and the Hon'ble Mr. Playfair.

15th September 1913.

A. G. BIRT,

Deputy Director of Agriculture, Assam.

MAP
OF
JORHAT FARM

Scale 32 Inches = 1 Mile

D. O. Shillong R. S. No. 585 of 1912

Appendix—A Note by Mr. Meggitt on soil acidity and the use of lime.

Further notes on soil acidity and the agricultural use of lime.

Last year's report (year ending 30th June 1912) contained a general note on the occurrence of acidity in high-land soils, and some aspects of the usefulness of lime as a corrective.

The present note is an extension of the above, based largely on the experience acquired during some five years' work in the field and Laboratory on the liming problem.

When liming is necessary.—It is not easy to indicate clearly every case in which liming will prove beneficial.

There are certain signs, however, which point to its necessity for the best growth of most cultivated plants, *i.e.*, when the soil is sour either as a result of excessive leaching out of lime compounds in tracts of heavy rainfall, or from the presence of fertiliser residues or excessive amounts of organic matter, or from combinations of the above causes; when such plants are sorrel, rushes and sedges, certain coarse creeping grasses, etc., are relatively abundant; when clay soils become too sticky and cultivation and drainage are difficult; when the soil fails to respond adequately to manuring; in all such cases lime will prove helpful.

It will also prove useful in those cases where leguminous crops, as commonly used for green-manuring purposes, fail or do not make proper growth, except when heavily manured beforehand. One point must here be emphasized and that is that in such cases liming alone will generally prove insufficient. By rendering available the reserve food supply of the soil it may act favourably for a time, ultimately leading to a measure of soil exhaustion.

The great thing when liming is practised is to keep up the supply of humus by green-manuring and the use of organic manures, and it is fortunate that lime generally assists the growth of green crops very considerably.

At the same time the systematic supply of other manures must not be neglected. Of such manures some, notably phosphates, will, especially on red stiff soils, be considerably more effective after a preliminary liming.

Time and manner of application.—Early in the year, about February or March, is probably the best time to apply lime dressings, as by that time cold weather crops are off the ground and opportunity is given before the rains-crops are sown of thoroughly working the lime into the soil, and this course also allows time for the lime to sweeten the soil. Lime, in whatever form it may be used, should always be applied alone and usually some few weeks in advance of other manuring, otherwise losses may occur when using certain manures.

It should never be spread when the soil is in a very wet condition, particularly on clay soils. On very sticky clay soils attention to drainage should always precede liming.

The lime should be broadcasted evenly over the land and thoroughly worked into the surface soil as soon after as possible. It is necessary to emphasize this as otherwise the lime will not exert its full early effect, and undue local alkalinity may ensue due to uneven application, if the application is at all a large one. Further, if heavy rain follow, the lime may be washed off the surface into the drains. Our experiments have shown that added lime takes an appreciable time to enter into its various combinations in the soil, and until it becomes thus fixed it is subject to greater loss in drainage water. This loss of lime to the surface soil will be greater the heavier the dressing, unless special care be taken to incorporate it well soon after spreading. The thoroughness with which this can be done, and the depth to which the lime is thus incorporated with the soil, are amongst the factors to be taken into account in deciding what amount of lime to apply in any given case.

Quantity of lime to be applied.—This depends upon a number of considerations, and speaking generally it is safe to say that nothing less than actual experiment over a number of years for any particular kind of soil and cropping and climatic conditions can properly decide the matter.

There is probably no phase of agricultural practice upon which a greater diversity of opinion may be found in literature than in regard to the question of liming.

Customs which appear to be thoroughly justified by practical experience in one country and on a certain class of soil, may not give the same results on a similar class of soil in another country.

Practical experience then as a result of careful, well-planned schemes of experiment, is what is most to be desired.

Speaking generally, one finds a very general agreement that in very wet climates clay lands will benefit much as a rule from liming, while light sandy soils respond readily when sufficient organic matter is naturally present, or is added, for the lime to act upon.

As regards what quantity may be safely and profitably applied, such considerations as the re-action of the soil (*i.e.*, whether acid or not and the amount of acidity); the amount of organic matter present or which can be added by green-manuring, etc., the texture, whether heavy or light, the cropping to be followed, must all be taken into account.

The greater the acidity the more lime will be required to sweeten the soil, leading to those favourable biological conditions which are associated with maximum crop production in the case of most cultivated plants.

Since lime hastens the decomposition of organic matter, if it is applied, in absence of green-manuring or supplies or other organic manures, in too heavy doses to soils already deficient in humus, it may lead to excessive exhaustion in respect of this most valuable soil constituent.

It is generally agreed that clays can bear more lime than light sandy loams, on account of the extra amount stiff soils require to keep their texture right.

At Jorhat where the soil is light the heaviest dressing of lime (2 tons per acre) depressed the yield of early cropping where green-manuring and cowdung were not also used; on the other hand, where they were applied, even this heavy application of lime increased the yield, though far from profitably, over that given by the next smaller quantity, *viz.*, 1 ton per acre.

At Dacca where the soil is stiffer and contains much more clay, the above early adverse effect of the heaviest lime dressings was not apparent.

In regard to the influence of the cropping to be followed upon quantity of lime to apply, it is undoubtedly a fact, which our experiments have confirmed, that some crops are more tolerant to a certain measure of soil acidity than others, so that other conditions being suitable smaller applications will enable the former to yield well.

Formerly the custom in Europe was to use very heavy dressings at relatively long periods. Liming was overdone and fell into disuse, the latter being hastened by the advent of artificial fertilisers. There is to-day a distinct recrudescence of the practice of liming, and latterly small dressings at more frequent intervals have become customary. Obviously the quantity to be applied must depend upon the frequency of application, as well as on the purpose it is sought to accomplish.

In certain cases a fairly large initial dressing may be advantageous, but it would be well first to prove by actual test that the larger dressings actually give a profit over and above that yielded by smaller ones, before going to the expense of heavy applications.

Smaller dressings at more frequent intervals are more likely to prove economical in the long run than large doses at longer intervals, because lime does not exert its maximum effect over

very many years, and is one of the soil constituents that is most quickly removed in drainage water, in this way being lost to the surface soil where its presence is most to be desired.

Our experiments show that the loss by drainage following the application of the larger doses of slaked lime is greater than in the cases of the smaller dressings.

For light soils almost certainly light dressings applied more frequently should be the rule.

Where the surface soil is very deep and deep cultivation is practised, the application at any one time may be proportionately increased.

Though our field experiments at Jorhat and Dacca are still too young to speak positively on the point, up to date they appear to favour the smaller and more frequent applications as being likely to prove the more economical in the long run. At any rate where large areas are to be treated, there is ample justification on all grounds for saying that, in the absence of direct experimental results to the contrary, the safest and sanest policy to pursue will prove to be to use moderate dressings, say up to 10 or 15 maunds per acre at first, though a repetition at no distant date may prove advantageous, since in many parts of the Assam Valley and Bengal such an amount of lime is quite insufficient to neutralise the acidity, and thus establish healthy soil conditions even in the first three inches of soil.

Indeed our work shows that very much larger applications would be necessary to establish even a very small working reserve of carbonate of lime in the surface soil.

On the light sandy loam at Jorhat, experience so far goes to show that about 30 maunds slaked lime is the maximum permissible initial dose per acre. Even this quantity only sweetened the surface soil to a depth of some 3 inches for a comparatively short period.

Eighteen months after the above application, the surface soil had become sour again, indicating that for general cropping more lime will soon be required.

While it is thus fairly clear that some 30 maunds is probably the maximum dressing permissible initially on this class of soil, it does not at all follow that it will prove in the end more economical than smaller doses repeated at intervals. Time alone can decide this point.

Frequency of liming.—This will depend largely on circumstances. Where a single initial heavy dressing has been given, its effects may persist for a number of years, say 6 to 10, and in

many cases a ton per acre applied once in 6 to 10 years would suffice.

But on arable land in heavy rainfall tracts it may well prove that subsequent applications will need to be more frequent if the soil is to be kept in the best condition.

In this connection it is well to recall that lime carbonate is one of the least permanent soil constituents. The average loss for England and Wales is estimated at some 500lbs. per acre per annum in drainage water.

It is true that the annual loss may be influenced by the choice of manures, *e.g.*, increasing where sulphate of ammonia is used, and diminishing with increased use of cowdung, and very probably where green manuring is regular.

Again on arable land it is greater than on pasture. In countries of heavy rainfall it is quite likely that the annual loss to the soil will exceed the figures given above.

Allowing the annual loss by drainage to be not greater than 500lbs. carbonate of lime per annum per acre, this would require an addition of good slaked lime (containing 70 per cent. pure lime) at the rate of 5 maunds per annum, or say 20 maunds every four years.

However, this figure may well represent the maximum requirements, since added lime is generally only mixed with a comparatively shallow soil layer, and practically the whole of the lime remains in the surface soil, except that washed out by solution.

In practice it is not even necessary that a soil should be admixed with lime to any very great depth, since it is within a foot or so of the surface that the feeding roots of most plants are to be found, and where, moreover, the beneficial soil re-actions take place.

If then there be maintained a small working reserve of carbonate of lime in the first foot or so of the soil, it will keep the soil healthy, and provide all that is necessary to meet changed conditions in time of drought, when the up-coming capillary water brings soil acids with it from below.

It may well prove then that even on heavy clay soils which admittedly require a higher percentage of carbonate of lime to keep them in condition than lighter soils do, that once the soil has been got into fair condition an application of 15 maunds of slaked lime once in 4 to 6 years may suffice to keep them in good tilth and fertility.

On lighter more sandy soils otherwise under similar conditions an amount of 8 to 10 maunds every 4 to 6 years may prove sufficient.

In the latter case, more especially, it will probably prove more advantageous to apply, say, 4 or 5 maunds every 3rd year than 8 to 10 maunds every 6th year.

The above figures are for slaked lime of good quality.

If ground limestone be used instead, then the quantities to be applied will be from one and a half times to twice as large, depending on the composition and fineness of the ground limestone.

Form of lime to use.—Experience does not yet provide the full answer to the question as to which form of lime is the best to use, *i.e.*, slaked lime or carbonate of lime, in all circumstances. Literature provides instances in favour of either as against the other.

A marked preference for burnt lime on stiff soils exists; this may or may not be due to the fact that burnt lime has always been readily obtainable, while limestone in a sufficiently fine state could not be bought.

More recently finely ground limestone has been experimented with largely in America with the very best results in practice.

For various reasons it is generally assumed that burnt lime must become converted into carbonate of lime very soon after it is mixed with the soil.

This may very well not be the case on acid soils at first, since added lime will immediately combine with the soil organic acids to form neutral salts.

This appears certainly to have been the case at Jorhat, where in searching for reasons for the remarkable early beneficial action of lime, I have not been able to detect by the most delicate tests any increase in the percentage of carbonate of lime in the surface soil from even the 60 maunds lime plots some 12 months after the application, while even only 3 months after spreading the lime, though there was a very slight accession of carbonate, it was not sufficient to account for more than one-fifth of the lime which had been added.

On the other hand, other tests showed that one of the very earliest actions of the lime was to combine with the objectionable soil organic acids to form insoluble lime compounds of a favourable character.

It may well prove then that for very sour soils, whether light or heavy, also for stiff clay soils for reasons which will presently appear, the use of slaked lime as a preliminary soil ameliorant may have a time advantage over ground limestone, as it would overcome scurness more quickly, and on stiff soils it acts more rapidly in improving the texture.

Further, the caustic action of burnt lime as a fungicide is not exercised by the milder carbonate.

In certain cases there thus appears to be strong evidence favouring the use of burnt or caustic lime in correcting bad soil conditions, but once the soil has been brought into fair condition, there are the very best reasons for saying that in order to keep up this favourable condition, for subsequent applications a finely ground limestone will have all the advantages, and none of the disadvantages which sometimes attend the use of burnt lime.

I believe that the only advantage of using burnt lime in certain cases rather than limestone lies chiefly in the fact that certain ends may be achieved in less time.

Some of the desirable effects which it is sought to bring about in a soil by the use of lime are as follows:—The correction of sourness, the improvement of texture, the improvement of biological processes, and the liberation of available plant foods from insoluble reserves.

As regards the correction of sourness, finely ground limestone is quite effective, though somewhat slower in action than burnt lime.

Improvement in the texture of stiff soils by liming is due to flocculation of the fine clay particles. Bicarbonate of lime has this power, and bicarbonate is readily formed in the soil after the use of limestone, but flocculation cannot take place until the carbonate of lime contained in the limestone has been converted into the soluble bicarbonate. Thus it may take a longer period of time to effect a marked change in a clay soil as regards texture when using limestone, than would be necessary if burnt lime were used, because the burnt or hot lime as such itself has a marked flocculating action which may be exercised appreciably before it becomes carbonated. Once it has been carbonated any further flocculating action depends, as in the case of limestone, upon its conversion into the soluble bicarbonate in the soil.

With regard to improvements in soil biological processes, Warington found that lime water was much too alkaline for nitrifying organisms, and more recent work clearly shows that the

use of caustic lime does at first have an inhibitory effect on nitrification; very possibly the same may be true of other biological soil processes. This early inhibitory action of the lime, however, is not of long duration, and is followed by increased activity of the nitrifying organisms.

The use of the milder carbonate of lime in the form of ground limestone more favourably affects nitrification. Carbonate of lime again is capable of liberating available plant foods, *e.g.*, potash from the insoluble reserves. At Rothamsted, chalk applied to the permanent grass plots both increased the crops and materially changed the character of the herbage, these results being attributed to liberation of potash from the stores in the soil.

From the above it will be seen that all these beneficial soil processes may be ensured by the use of a finely powdered limestone.

At Jorhat a preliminary experiment in the use of ground limestone has shown the same favourable action as has been obtained by using slaked lime on our ordinary agricultural cropping.

It is slower, perceptibly so, in action but it is sure and safe, and except perhaps in those cases above noted, *i.e.*, when the soil is very sour or on clay soils where texture is bad and drainage difficult, for which cases burnt lime may suitably be used for the early applications, except in these cases the use of a finely ground limestone may be strongly recommended.

Even in the case of exceptionally bad soils where burnt lime is used at first to ensure an early improvement (and more recent work at Jornat has proved the vital necessity of first getting rid of acidity as a preliminary to further treatment) for future recurring dressings after the land has been got into fair condition, limestone will form the most suitable addition.

All the benefits which follow the case of caustic lime will be obtained, but in somewhat greater time.

Again limestone can be safely mixed with certain manures without danger of loss, which is not true of caustic lime though the separate addition of lime in any form is to be advocated.

Limestone has a milder action in decomposing organic matter in the soil, the amount of which is in many cases already all too small. Even this consideration must not be made an excuse for not green-manuring regularly, if the most is to be made of the soil's resources and of other manures applied.

It is further much easier and more pleasant to apply than slaked lime, and the consequences of the use of an accidental overdose are negligible compared with those which may follow the use of too much of the latter.

It is necessary to point out that even with high quality limestone containing some 90 per cent. carbonate of lime, to supply a given quantity of pure lime will need about one and a half times as much limestone as if one were using a good slaked lime containing some 70 per cent. pure lime.

Where immediate results are required, the finer the limestone is ground the quicker it will act, and less of it will be required to serve an immediate end than if one used a coarse product.

If ground to all pass a sieve of 50 or 60 meshes to the linear inch, it will act very quickly indeed.

In such cases therefore where limestone is being used for early applications, rather than slaked lime, it should preferably all pass a 60 mesh sieve.

Once better soil conditions have been established however, and to prevent a relapse of the soil into sourness, for future additions a coarser and therefore probably cheaper product would answer well, and for this purpose, provided all the finest material produced during the grinding be included, I am of opinion that it will do very well if it will all pass a 30 mesh sieve; this would mean that a very considerable proportion would pass a very much finer sieve.

The present position in regard to the supply of ground limestone on the Indian market is in a very unsatisfactory state indeed.

There is springing up a demand for this commodity which even to-day can only be partially met, and the demand seems likely to increase rapidly.

In a province where its use would appear to be fraught with such great possibilities, *e.g.*, Assam, it can hardly be obtained and then only at a comparatively excessive cost.

In America (Illinois) ground limestone can be bought delivered 100 miles by rail from the quarry at 1 dollar 20 cents or Rs. 4 approximate per ton. Even where it must be railed much longer distances the equivalent of Rs. 15 per ton delivered is considered so excessive as to make its use prohibitive.

It is stated that the grinding can be done for 25 cents a ton where a large plant with powerful machinery is used and where fuel is cheap, as near the coal mining districts.

This is probably not very fine grinding, but even in this case one cannot conceive that the cost of grinding can exceed a very few rupees per ton.

Co-operation amongst large users should succeed in reducing the present excessive cost to a reasonable figure.

What will happen in practice will almost certainly be that all other considerations will be subordinated to that of relative cost, and this is a point which it would be well for the trade to recognise.

Early chemical and physical effects of lime on acid soils.—Coincident with improved cropping, certain very definite chemical and physical effects have been observed in our experiments at Jorhat and Dacca.

The most obvious has been the partial or complete neutralisation of acidity (according to the amount of lime used), a change which is almost entirely confined to the cultivated surface layer. This has a very evident important bearing on the subject of liming. A temporary but quickly fugitive very slight increase in the per cent. of carbonate of lime followed the application of the large initial dressings.

A definite combination of lime with organic compounds of an acid nature, to form the so-called calcium humates, which constitute the active organic matter of the soil, was early demonstrable. A decrease in the stiffness of the straw on the more heavily limed plots indicates further and more obscure combinations of lime with inorganic compounds of an acid character. This is being investigated.

Improvement in physical texture is clearly marked on the heavy soil at Dacca; it is less sticky and easier to work. At Jorhat the greatest improvement noticeable to date is in the physical condition of the sub-soil which in the natural condition shows a tendency of pan.

The increased efficiency of insoluble phosphates when used along with lime as measured by solubility in weak acid solvents, is very clearly marked. It is also reflected in the crop yields.

It seems perfectly obvious that before there can be formed any reserve of carbonate of lime in the soil—and a small reserve is desirable in tracts of permanently acidifying conditions—the soil acids must first be neutralised, and in addition other possible soil combinations must be satisfied, and it appears very likely that over many parts of the Assam Valley it will require more lime to effect this than may be commonly supposed by those who have no positive experimental evidence on the point.

While sandy soils can get along well with as little as 0·1 per cent. of carbonate of lime, it requires more than this to keep stiffer soil in good condition.

In this connection and in reference to the ascertained presence of a definitely toxic substance in the Jorhat soil, recent work by the American Bureau of soils has rendered it quite clear that certain of the decomposition products formed in soils during the breaking down of organic matter may be beneficial to the plant, others definitely harmful, and upon what sort of soil treatment is given depends largely whether toxic substances shall accumulate to such an extent as to exert a definitely poisonous effect on crops.

Among the causes contributing to the presence of a deliterious bio-chemical soil factor with resulting accumulation of toxic soil compounds are :—

(1) Absence of a sufficiency of carbonate of lime.

(2) Insufficient drainage.

(3) Poor cultivation.

It is certainly possible by paying attention to the above points to ensure that the soil bio-chemical factor shall be favourable; the result being that the various soil processes will tend to the formation of such compounds as are not only not toxic but are positively beneficial, contributing directly to the food supply and general welfare of the plant.

To get the maximum value therefore out of the soil and from added manures, it is necessary to get and keep this bio-chemical factor right, and this is quite incompatible with the presence of acidity and absence of carbonate of lime, so far as most of the cultivated crops are concerned.

The periodical supply of lime therefore, combined with proper attention to drainage and cultivation, would appear to form the very corner stone of any attempt at permanent improvement of adverse soil conditions.

The scientific work which is now being done in this field of soil chemistry is, amongst other things, supplying the reasons for a practice which has long been in vogue amongst farmers almost the world over, *viz.*, the use of lime in those cases where applications of manure fail to correspondingly increase the crop. A sound application of the *raison d'être* of this custom would be a good thing in certain parts of India too.

Relation between heavy rainfall and the effect of soil acidity on cropping.—Particulary at Jorhat, less markedly at Dacca, has it been noticeable that lime exercises a very much greater

effect on cold weather cropping as compared with many rain crops.

This difference is probably not unconnected with the very divergent soil conditions which obtain during the two seasons.

In the rains the amount of soil moisture is high, leading to a lower concentration of soil acidity, and also down percolation is constant. In the cold weather when percolation is small or nil, the lower soil moisture content coupled with the rise of capillary water from below would tend to increase the concentration of acidity in the surface soil.

This may partly explain why certain crops, *e.g.*, *matikalai*, grown in the rains generally make much more vegetative growth than when taken as a cold weather crop, and also why, with the exception of *jowar* which responds in a most extraordinary way to liming in the rains, other rains crops, *e.g.*, groundnut, cow-peas, etc., though benefiting very materially from lime, do not show that vast superiority which is so manifest on cold weather cropping, *e.g.*, oats, mustard, barley, etc.

For rain crops it will be, I take it, during seasons of short rainfall or during dry spells within individual seasons, that lime will have its greatest effect. Crops like soy-beans which continue their growing period into the dry weather months, have also shown at Jorhat to derive the greatest benefit from lime applications.

While we have thus shown that certain legumes, *e.g.*, soy-beans, groundnut, etc., will grow in the absence of lime during the rains and even develop root nodules, the improvement in their growth and colour which is manifest after the use of lime suggests that these crops in its absence possesses a relatively smaller power to fix atmospheric nitrogen.

They may be forced, in the absence of lime, to more or less luxuriant growth by the application of good dressings of cow-dung, cake, etc., but in such cases they must undoubtedly take a very large part of their nitrogen from the manure supplied, rather than from the air, and though far from deprecating the use of a certain amount of manure to help along the growth of a green-manure crop in some cases, it would appear economical to use a preliminary lime dressing in addition, which will not only assist the green crop but also help to decompose it later on and turn its decomposition into the best channels.

Possible injury by injudicious liming.—Reference has already been made to the care which is necessary in using lime on poor light soils deficient in organic matter, and to the urgent necessity of combining green-manuring with the use of lime in such cases.

It is necessary also to point out that even clay soils may ultimately become solid and compact rather than friable and easy working, if applications of lime be too frequent and in excessive quantities. This is due to a cementing action of carbonate of lime similar to the change which takes place in mortar.

Similar injury may result upon the excessive use of burnt lime on a clay soil in too wet a condition. The necessity for attention to drainage in such cases is to be reiterated.

It is to be observed also that in some soils a pan exists between surface and sub-soil, which alike impedes the range of plant roots and movement of water from below in dry periods. Variation in the depth of cultivation from time to time, combined with the moderate use of lime, will generally prevent the formation of these pans. Once such a pan is already formed however it may even be aggravated by too heavy liming, forming what is known as lime pan.

In case heavy liming is for exceptional reasons indicated as desirable in any particulary case, it is well to see that there is no hard pan present.

Particularly in its destructive action on organic matter lies the danger of the too frequent use of lime. It is to the abuse, rather than the proper use, of lime that we owe the existence of such proverbs as this—

"Lime and lime without manure
Makes both farm and farmer poor."

As Storer remarks "when the use of lime first became general in Europe, the farmers were prone to believe that it could be used as a substitute for stable manure. Hence a tendency to abuse in using it. No doubt many a field has been reduced to the verge of sterility by applying lime until the entire store of available nitrogen, phosphoric acid and potash has been used up. All the evidence teaches that lime is no substitute for manure; it is a mere addition or reinforcement which may occasionally be employed with advantage."

Again Storer has it that "excepting for clays and in some cases where it may do good as a means of correcting sourness, lime is not a thing to apply to really poor land. Generally speaking, it can hardly be profitable unless the soil is already fairly well charged with the constituents of plant food. Its function is to alter and improve matters that are already in the soil, and to make them more easily available for crops, as well as to bring the soil into such condition that it can enable added fertilisers to be put to better use than they could have been without the liming. It is an adjunct to be used occasionally, but no proper substitute for manure.

In other words occasional liming with systematic attention to manuring should go hand in hand together.

In conclusion, no better advice can be given to those who wish to really learn more about the subject than that they should experiment for themselves—preferably under scientific guidance and control—but experiment and be guided by results.

A. A. MEGGITT,

Agricultural Chemist, Bengal.

REPORT

ON THE

UPPER SHILLONG AGRICULTURAL EXPERIMENT STATION

FOR THE YEAR ENDING

JUNE 30TH, 1913.

History and description.

The Upper Shillong Agricultural Station was established in 1897-1898. It is situated on the Cherrapunjee road, 5½ miles from the town of Shillong, and occupies the site of the old "Model Farm" which ceased to exist in 1879. The elevation of the station is 5,900 feet, *i.e.*, about 900 feet higher than Shillong town. A large area of pine forest was annexed to the station in 1905. The total area of the farm, inclusive of forest, is 336·67 acres. Most of the cultivated land lies on the slope of a long narrow valley, the bottom of which consists for the most part of marshy land covered with a thick growth of wild grass. A considerable area of land has been reclaimed by deepening and straightening the stream which drains the valley and cutting lateral nullahs to connect with it. This work is being continued and extended, but the results of the work already done are very apparent. Soft boggy ground on which previously it was unsafe to work has been converted into firm pasture land, and at the same time the herbage shows a marked change for the better.

The soil of the greater part of the station is a coarse reddish loam of very loose texture which can be worked with the greatest ease. The sub-soil is of a more pronounced reddish colour and of great depth. In a small portion of the station the soil is black owing, it is believed, to the existence of some mineral compound. The soils have not been analysed. In point of quality, they are extremely poor, and very little can be grown on them without the help of manure. At the bottom of the valley a different type of soil is found, namely, clay or clayey loam, extremely rich in organic matter. Having been under a thick growth of grass for many years, the upper portion of this soil is a matted mass of half decayed grass roots.

Besides the natural poverty of the soil, the greater portion of the station suffers from the disadvantages of an exposed situation. It is colder and more windy than Shillong: frosts are of very common occurrence and are more severe than the town. During the winter the growth of vegetation is entirely suspended.

Purposes of the station.

2. The main objects for which the station was established were the introduction of superior varieties of potatoes—which are the most important crop grown on the plateau of the Khasi Hills—the breeding of improved strains of cattle suitable for this tract, and the cultivation of fodder crops and making of ensilage for use in winter when green fodder is short. These objects are still kept in view, and in addition sheep-breeding experiments with the object of improving the local breed have since been commenced.

Weather.

3. The following table gives the rainfall during the year under report :—

	Inches.
1912—	
July	18·27
August	10·98
September	10·45
October	10·98
November	5·29
December	0·10
1913—	
January	0·06
February	2·06
March	1·84
April	2·51
May	11·67
June	25·81
Total	100·02

Although the total rainfall was well above the average (90·8 inches being the average for the last 14 years), it was deficient in March and April and specially so in the latter month. This was extremely detrimental to the growth of the potato crop, which, on the cultivators' holdings in the neighbourhood, began to die off in April, with the result that many people scarcely got back more than their seed.

The crop on the farm suffered to some extent, the yields being below the average, but nevertheless produced sufficient to shew a good margin of profit. This was undoubtedly due to a great extent to the superior methods of cultivation followed on the farm where the land is ploughed up about 8 inches deep with an English plough in the autumn and allowed to weather throughout the winter; although the fact that our crop was planted rather later than that of the cultivators was also in our favour, as the plants being younger were able to benefit from the rain in May.

For the cultivator of only one acre of potatoes in these hills, I am convinced that the purchase of an English plough would be advisable, provided his land is not too hilly: as in an average season the increased yield of potatoes, due to the better conservation of moisture in spring made possible by deep cultivation, would more than pay the cost of the implement. The price of the plough which we recommend is about Rs. 50 delivered at Shillong. There is a smaller plough costing less than this, but it is not so efficient. Any cultivators wishing to purchase these ploughs should apply to the Farm Superintendent, Upper Shillong. For very small holders I would suggest that several club together and purchase a plough. Failing this there would be a good opening for an enterprising man owning two pairs of good bullocks to purchase a plough, and take up contracts for ploughing at so much an acre. The larger plough will do about 2 acres in three days. Anyone wishing to take this up, can be taught to use the plough at the Government Farm, on application to the Farm Superintendent.

Construction work.

4. During the year the following buildings were constructed:—

	Rs.
Farm Superintendent's quarters	1,160
Fieldmen and clerk's quarters	997
Inspection bungalow (including servant's quarters and stable).	1,336

The cost shewn is exclusive of timber which was supplied from the farm forest.

The road from the Cherra main road to the farm godown was metalled at a cost of Rs. 300.

A cylindrical pit silo 14′×11′ with a thatched roof was sunk at a cost of Rs. 34.

Summary of work.

5. The work done during the year included :—

Reclamation.

Potato experiments.

Potato growing for seed.

Rice experiments.

Trials of various new fodder crops.

Other crops.

Selection experiments.

Growing indigenous fodder crops on a large scale for silage and hay.

Cattle breeding.

Sheep breeding.

Reclamation.

6. It was mentioned in last year's report that an attempt had been made to bring a portion of the peaty soil in the valley under cultivation by a system of open drains. This was not very successful owing to the drains being too far apart. Any extension of this system was, however, undesirable since, if a sufficient number of open drains were employed, the land would be cut up into sections too small for bullock-power cultivation. Consequently this year a system of feeder drains was employed, the drains being partially filled up with brush-wood and finally covered in with earth. This method is working very well; a good portion of the marshy land in the upper part of the valley has been made dry enough for cultural operations, and, now that cultivation has been commenced, the condition of the soil should improve from year to year. A portion in the lower part of the cultivated area, however, is still insufficiently drained, and this will be attended to next cold weather.

Altogether 11 acres of land were reclaimed; nine acres were sown with *Raishan* and two acres with rice. The rice land was laid out in $\frac{1}{10}$ acre plots.

In addition to the above, an area of about two acres of land carrying coarse jungle grass was ploughed up and cultivated during the cold weather, and, after levelling, was allowed to go down to grass again. This was with a view to improve the natural herbage, as it had been observed that one or two small patches of land which had gone out of cultivation were carrying finer grasses than the coarse herbage which forms the natural pasture on the uncultivated area. The grazing on the area so treated is already much improved, so it is proposed to extend the operations next year to other similar areas.

Potato experiments.

7. These included :—

(*a*) Variety tests.

(*b*) Summer grown *versus* winter grown seed.

(*c*) Whole *versus* cut sets.

(*d*) Manuring experiment.

(*e*) Trial of old sets.

Variety tests.

8. The following varieties were compared on duplicate plots, each $\frac{1}{40}$th acre in area :—

Khasi Round, obtained locally in	...	...	1900
Khasi Nainital ditto	...	...	1908
King Edward VII, from England		...	1906
Sutton's Magnum Bonum, ditto	...	...	1908
Winsor Castle, ditto	...	...	1909
British Queen, ditto	...	...	1909
Up-to-Date, ditto	...	...	1909
King of Potatoes, ditto	...	...	1912
Magnum Bonum, ditto	...	...	1912
Windsor Castle, ditto	...	...	1912
British Queen, ditto	...	...	1912
Gladiator, ditto	...	...	1912
Flour Ball, ditto	...	...	1912
Harbinger, ditto	...	...	1912
Imperator, ditto	...	...	1912
Belle de Juliet, ditto	...	...	1912
White City, ditto	...	...	1912
Californian, from California		...	1912

All the varieties were planted in March and harvested in July. Sets were from the previous winter crop. The land was given a dressing of 300 maunds of cowdung and 10 maunds of rape cake per acre, and the crop was sprayed with 240 gallons of Bordeaux mixture per acre in two equal doses.

The following statement shows the average yield per acre *on duplicate plots for the last six years.*

Variety.	1913.		1912.		1911.		1910.		1909.		1908.		Average of last two years.		Average of six years.	
1	2		3		4		5		6		7		8		9	
	Mds	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds	srs.	Mds.	srs.
1. King of Potatoes	186	20	234	0	201	0	131	20	95	30	319	0	210	10	194	25
2. Magnum Bonum (1908)	165	20	232	0	160	35	132	20	87	30	277	0	198	30	175	37
3. King Edward VII	133	20	128	20	163	13	78	20	90	15	269	0	131	0	143	34
4. Khasi Nainital	174	10	166	20	157	30	119	0	111	30	292	0	170	15	170	8
5. Khasi Round	123	0	111	20	135	2	95	25	102	25	255	0	117	10	137	5
6. Windsor Castle	158	20	205	0	181	15	63	15	...		...		181	30	...	
7. British Queen	152	30	181	20	169	3	92	30	...		...		167	5	...	
8. Up-to-Date	186	20	178	0	153	0	90	0	...		...		182	10	...	
9. Magnum Bonum (1912)	156	0	224	0	...		...		...		...		190	0	...	
10. Windsor Castle (1912)	129	0	196	0	...		...		...		...		162	20	...	
11. British Queen (1912)	142	10	72	20	...		...		...		...		107	15	...	
12. Gladiator (1912)	127	10	93	20	...		...		...		...		110	15	...	
13. Flour Ball (1912)	160	30	173	0	...		...		...		...		166	35	...	
14. Harbinger (1912)	108	30	126	0	...		...		...		...		117	15	...	
15. Imperator (1912)	167	20	211	0	...		...		...		...		189	10	...	
16. Belle de Juliet (1912)	63	20	81	20	...		...		...		...		72	20	...	
17. White City (1912)	82	0	80	20	...		...		...		...		81	10	...	
18. Californian	9	25	...		...		...		...		...		...		...	

Of the older varieties King of Potatoes has again given the heaviest yield, while Khasi Nanital and Magnum Bonum are also good. Khasi Nainital is really the old Magnum Bonum variety which was introduced into the Khasi Hills from Nanital many years ago. This variety is still very largely grown by cultivators, but has become susceptible to disease. On an average of 6 years' results King of Potatoes is first as regards yield, followed by Magnum Bonum and Khasi Nainital.

Of the varieties more recently imported, Up-to-Date and Imperator are the most promising, Up-to-Date having doubled its yield since it was first imported.

As in former years, 50 tubers of each variety were selected at random, cut open and examined for signs of disease. The following table gives the results of the last five years :—

Variety.	Number of diseased tubers.				
	1909.	1910.	1911.	1912	1913.
King of Potatoes*	10	12	Nil	Nil	Nil
Magnum Bonum (1908)	...	6	4	2	4
King Edward VII	Nil	18	8	4	6
Khasi Nainital	10	48	16	8	4
Khasi Round	Nil	4	8	6	10
Windsor Castle	...	...	...	4	3
British Queen	Nil	12	Nil	6	4
Up-to-Date	...	4	32	16	4
Magnum Bonum (1912)	...	...	...	6	6
Windsor Castle (1912)	...	...	...	4	3
British Queen (1912)	...	...	...	4	4
Gladiator (1912)	...	...	...	8	4
Flour Ball (1912)	...	...	...	6	3
Harbinger (1912)	...	...	...	2	8
Imperator (1912)	...	...	...	22	3
Belle de Juliet (1912)	...	...	...	6	Nil
White City (1912)	...	...	...	10	9
Californian	...	...	...	...	3

* Figures for 1909-11 are for the old stock of King of Potatoes imported in 1906, while those for 1912-13 are for the new stock imported in 1912.

These figures must not be regarded as an absolute test of the amount of disease in the crop, but taken over a series of years they indicate to some extent the comparative disease-resisting power of the several varieties. King of Potatoes stands easily first as regards freedom from disease, in addition to being the heaviest cropper. Khasi Nainital, which according to this test was diseased to the extent of 96 per cent. in 1910, has gradually improved, until now only 8 per cent. are returned as diseased. It is only fair to state, however, that this variety returned more completely rotten potatoes at harvest time than any of the other varieties.

9. These experiments have been carried out for several years with the result that it has been definitely proved that winter "seed" (*i.e.*, "seed" produced from a second crop planted in August and harvested in November) is much more productive than "seed" saved from the summer crop, and that whole sets are superior to cut sets in the case of summer grown "seed." With regard to whole *v.* cut sets in the case of winter grown "seed," the results of the experiments made in 1911 and 1912 were contradictory, the 1911 experiments indicating that cut sets were more productive, while in 1912 the results were decidedly in favour of whole sets. For this reason the experiments were repeated in 1913.

Summer grown *v.* Winter grown seed and Whole sets *v.* Cut sets.

As in former years the experiments were divided into two series. In one series the same numbers of sets were used, but the weight of cut sets was only about half that of the whole sets, while in the second series the sets were approximately equal both in number and weight. This year, in addition to the plots in each series being duplicated, the experiment was carried out with two varieties, *viz.*, "King of Potatoes" and "Magnum Bonum" instead of with only one variety. Each plot was 1-40th acre in area and was manured with 300 mds. of cowdung and 10 mds. of rape cake per acre.

The following tables give the results obtained in 1913 :—

SERIES I.

Equal numbers of sets—seed rate of whole sets 12 *maunds and of cut sets* 6 *maunds per acre.*

Kind of sets used.	Magnum Bonum.		King of Potatoes.		Average of two varieties.
	Yield per acre.	Average.	Yield per acre.	Average.	Per acre.
	Mds.	Mds.	Mds.	Mds.	Mds.
Cut sets (winter seed)	177	177½	161	170	173½
Ditto ditto	178		179		
Whole sets (winter seed)	202	192	171	174	183
Ditto ditto	182		177		
Cut sets (summer seed)	90	69½	89	103	86½
Ditto ditto	49		117		
Whole sets (summer seed)	137	145	121	128	136½
Ditto ditto	153		135		

SERIES II.

Equal numbers and equal weights—seed rate 12 *maunds per acre.*

Kind of sets used.	Magnum Bonum.		King of Potatoes.		Average of two varieties.
	Yield per acre.	Average.	Yield per acre.	Average.	Per acre.
	Mds.	Mds.	Mds.	Mds.	Mds.
Cut sets (winter seed)	194	182½	172	175	178¾
Ditto ditto	171		17		
Whole sets (winter seed)	183	175½	167	168	171¾
Ditto ditto	168		169		
Cut sets (summer seed)	106	101½	92	103	102¼
Ditto ditto	97		114		
Whole sets (summer seed)	129	116½	100	115	115¾
Ditto ditto	104		130		

Winter "seed" in every case again shews an enormous superiority over summer "seed." In the case of summer "seed" whole sets appear to be preferable to cut sets, while for winter seed there is not very much difference. The most remarkable fact brought out by these figures, however, is that the yields in the case of cut sets have not been diminished to any very great extent by halving the weight of seed planted. The question of seed rate evidently needs further investigation; this will be taken up next year in order to determine the optimum seed rate for both whole and cut sets.

Experiments with winter versus summer seed will be discontinued in view of the definite results already obtained.

Manuring Experiment.

10. This is not strictly speaking a potato-manuring experiment. It is intended to compare the effect of cowdung alone and cowdung plus insoluble phosphates on limed and unlimed areas, through the following rotation :—

1st year Potatoes.
2nd ,, Maize.
3rd ,, Soybeans.

The plan of the experiment is as follows, each plot being $\frac{1}{40}$th acre in area :—

Plot No.	Lime. 6 5 4 3 2 1	No lime. 6 5 4 3 2 1
Plot No.	No lime. 6 5 4 3 2 1	Lime. 6 5 4 3 2 1

Slaked lime was applied at the rate of 10 maunds per acre about a month before the crop was planted, and the following manures were applied in the drills at the time of planting :—

Plots 1 and 4—300 maunds of cowdung per acre.

„ 2 and 5—300 maunds of cowdung plus 3 maunds of Flour phosphate per acre.

„ 3 and 6—300 maunds of cowdung plus 3 maunds of raw Bonemeal per acre.

The Flour phosphate and Bonemeal were mixed with the cowdung before application. Half the area was planted with King of Potatoes and the other half with Magnum Bonum potatoes at the rate of 10 maunds per acre.

The following tables shew the first year's results :—

King of Potatoes—Maunds per Acre.

Plots.	Manuring.	Limed.		Average.	Non-limed.		Average.
		Duplicate plot.	Duplicate plot.		Duplicate plot.	Duplicate plot.	
1 and 4	300 mds. cowdung per acre.	141	95	118	136	112	124
2 and 5	300 mds. cowdung per acre plus 3 mds. Flour phosphate per acre.	127	125	126	139	114	26½
3 and 6	300 mds. cowdung per acre plus 3 mds. Bonemeal per acre.	142	131	136½	126	112	119

Magnum Bonum—Maunds per Acre.

Plots.	Manuring.	Limed.		Average.	Nonlimed.		Average.
		Duplicate plot.	Duplicate plot.		Duplicate plot.	Duplicate plot.	
1 and 4	300 mds. cowdung per acre.	101	91	96	109	87	98
2 and 5	300 mds. cowdung per acre plus 3 mds. Flur phosphate per acre.	102	109	105½	109	106	107½
3 and 6	300 mds. cowdung per acre plus 3 mds. Bonemeal per acre.	113	115	114	116	115	115½

These experiments will have to be carried on for a number of years before reliable results can be obtained. It was not expected that the manurial dressings in addition to cowdung would shew up on the first potato crop, but next year the phosphates should benefit the maize crop, and in the following year the soybeans should shew the effect of both phosphates and lime.

Old Sets.

11. When harvesting the winter crop it had often been observed that many of the original sets were still sound, and when allowed to remain in the ground resulted in a large number of "self sown" potatoes. This year for the first time $\frac{1}{20}$th acre was planted with old sets of King of Potatoes which had already produced the winter crop. The result was rather astonishing, the yield from the old tubers being at the rate of 150 maunds per acre, which is above the average yield for the whole of the potato crop on the farm this year.

Although we would not advise people to make a regular practice of using old sets, still the above experiment shews that old sets might be used with advantage when the supply of new sets runs short.

Potatoes for seed.

12. From the 1912 crop, 605 maunds of King of Potatoes and Magnum Bonum were sold to cultivators for "seed" at a concession rate of Re. 1-8 per maund in order to advertise our superior "seed," the average bazar rate for potatoes being about Rs. 2 per maund. This year we grew $6\frac{1}{4}$ acres of King of Potatoes producing 600 maunds of "seed" and $3\frac{3}{5}$th acres of Magnum Bonum producing 438 maunds of "seed." Practically the whole of this is being sold to cultivators at Rs. 3-4 per maund, which is the average bazar rate this season.

In addition to this, over 100 maunds of King of Potatoes, 90 mds. of Magnum Bonum and smaller quantities of the other varieties produced on the experimental areas will be reserved for planting on the farm for the production of winter seed.

The manuring in the non-experimental areas was only 150 mds. of cowdung and 10 mds. of rape cake per acre, hence the smaller yields.

Rice Experiments.

13. Two acres of newly reclaimed marsh land was put under rice. The land was laid out in $\frac{1}{8}$th acre plots which were treated as follows:—

Plot No I.—No Manure.

" " II.—3 mds. Flour phosphate per acre.

" " III.—No manure.

" " IV.—3 mds. Bonemeal per acre.

" " V.—No Manure.

Plots VI to X are duplicates of I to V. The pots subsequently had to be divided into $\frac{1}{20}$th acre areas in order to facilitate irrigation. Half the area was sown with rice broadcast in the ordinary local way, the seed rate being 100lb per acre, and on the other half transplanting was tried with single plants about 6 inches apart, the seed rate required being only 25lb per acre. The transplanting of paddy is never practised in the higher valleys, the crop being always sown broadcast, with the result that a heavy seeding is required. If it were possible to substitute transplanting for broadcasting, there would be a saving of at least 75 per cent. in the seed rate. Another point in favour of transplanting is that it would tend to check the ravages of an insect named "Paintaphi"* (local) which eats the young paddy shoots, as the small areas of seed beds would be more easily controlled than the wide stretches of broadcasted land. This insect has been found to attack only very young plants, so transplanted paddy would probably be immune.

The experiment will be carried on for a number of years until reliable results are obtained. As the crop will not be harvested until November, the first year's results will be given in the next annual report.

Trials of Fodder Crops.

14. The following were tried in the Autumn of 1912:—

Radishes.—About an acre was sown in September, local seed being used. The total yield of green fodder and roots was 118 maunds, of which the greater part was fed to the sheep throughout the cold weather, a small quantity of roots being sold as vegetables.

* *Vide* Departmental Bulletin No. I of 1913.

Oats and Peas.—Seed from the plains was sown on about 3 acres partly as mixed and partly as pure crops. Germination was fairly good, but heavy rain in October destroyed the crop.

Rape.—Seed from the plains was sown on ½ acre in August. Germination was good, but the crop was battered by rain and was practically a failure.

Perennial Rye Grass and Alsike Clover.—Seed obtained from Sutton's (England) was sown mixed on $\frac{1}{10}$th acre in August. Both germinated well, but the Clover failed owing to heavy rain. The Rye Grass grew fairly well and is now seeding. The same happened in the case of Spring sowings.

The following were sown in the Spring of 1913:—

Lupins.—Seed was originally obtained from Sutton's last year. With the seed saved from last year's crop about $\frac{1}{10}$th acre was sown in May. The crop is doing well.

Darjeeling Soybean—Sown on about $\frac{1}{10}$th acre in May is doing fairly well.

Buckwheat.—About $\frac{1}{10}$th acre was sown in May with seed obtained from Nepali settlers. Germination was good and the crop is doing well.

Cowpeas.—Seed obtained from Rajshahi (Bengal) was sown on $\frac{1}{10}$th acre in May. Germination was good, but the crop subsequently died out.

Swedes.—About $\frac{1}{10}$th acre was sown in May with seed obtained from Sutton's. The land was manured with 300 maunds cowdung, 3 maunds Bonemeal and 3 maunds Flour phosphate per acre. Germination was good and the crop has made fair progress, but from the size of the roots at present it does not appear that the crop will be very productive. Still it appears to stand the heavy rains better than turnips.

Turnips.—These were sown at the same time as the Swedes on land manured similarly. The crop is not doing at all well.

Mangels and Sugar beet—Were sown in May, but failed to germinate.

Lucerne.—Seed obtained from England was sown in May. Germination was poor and heavy rain destroyed the few plants which germinated.

Jowar.—Seed obtained from the plains was sown on $\frac{1}{10}$th acre. Germination was poor and the crop failed.

Sword beans and Florida Velvet beans.—Seed was obtained from America and sown in June on small areas. Both germinated well, but the plants are stunted. The climate appears to be too wet and cold for these crops.

Trydip grass.—This is a good local fodder grass. Another attempt was made this year to grow it from seed on about $\frac{1}{10}$th acre. Germination was good, and the experiment is likely to be successful.

Australian grasses and Clovers.—Eight varieties of grasses and three of Clovers were obtained from Australia and sown mixed on about $\frac{2}{5}$ths acre. Each variety was also sown pure on a small plot. The seeds germinated fairly well, but all the young plants were destroyed by heavy rain in June and July.

Several attempts have now been made to introduce exotic fodder crops, and the result on the whole has been a decided failure. The climate conditions at this elevation are peculiar, the rainfall being very heavy between April and September, and scanty during the rest of the year. The winter is dry and cold, frosts occurring almost nightly from November till March, but snow falls very rarely, perhaps once in 10 years or so. The summer climate with its torrential rains does not suit English crops, and the winter is too cold and dry for them. We have, therefore, come to the conclusion that it would be useless to continue experiments with English fodder crops. Fortunately Maize grows well in these hills in the rains, and with this for silage, and *Raishan* (a local small millet) and indigenous soy-beans for hay, we are not dependent on the introduction of crops for winter fodder.

Other crops.

15. *American Maize.*—Seed of 5 varieties was saved from last year's crop and sown on small plots separately in different parts of the farm. Only two of the varieties, *viz.*, Early Huron Dent and Reid's Yellow Dent are doing well; the remainder germinated badly and subsequently suffered from the attacks of cut worms.

Rhubarb.—About $\frac{1}{10}$th acre was planted in October 1912, with plants removed from the fruit garden. The crop is flourishing.

Asparagus.—Plants from the fruit garden were put down on about $\frac{1}{3}$rd acre in October 1912. The crop is doing well and should give cuttings next year.

Strawberries.—Nine varieties, removed from the fruit garden in October 1912, were planted on about $\frac{1}{20}$th acre. The season was too late for transplanting and consequently very few plants survived. The blanks have been filled up by suckers.

Selection Experiments.

16. With a view to the isolation of superior varieties of local maize, a single cob (as nearly perfect as possible) of each of the following varieties was collected from the surrounding villages :—

Dembah.	Dem lieh.
Dem lynnap.	Dem saw.
Dem krai.	Dem Mylliem.
Dem sohriew.	Dem Synting.

A hundred seeds of each cob were sown separately on small plots in different parts of the farm. It remains to be seen whether all or any of these varieties are pure. It is proposed to evolve pure strains if possible and to attempt to improve them by selection.

Small quantities of "Job's tears" (a local millet) and "Sohplang" have been sown with the same object.

Fodder crops for Silage and Hay.

17. The following quantities of green fodder were ensiled in the Autumn of 1912 :—

—	*Pucca* silo.	Pit silo.	Total.
1	2	3	4
	Mds.	Mds.	Mds.
Maize	437½	719½	1,157
Langtylli grass	61	...	61
Wild grasses	20¼	146½	166¾
Total ensiled ...	518¾	866	1,384¾
Total recovered as good silage ...	294¾ (57 per cent.)	535¾ (62 per cent.)	830½ (60 per cent.)

The *pucca* silo built some years ago is semi-circular in section. This shape is a mistake, as the silage always goes bad in the corners. The pit silo was made as an experiment last year. It is cylindrical, being 14 feet in diameter by 11 feet deep. The cost of construction, including a thatched roof, was only Rs. 34. From the percentage of good silage obtained from the pit silo it will be seen that it is more efficient than the semi-circular *pucca* silo. In fact there appears to be no need to go to the expense of a *pucca* building when such good results can be obtained by simply digging a pit. A good high site should be chosen for a pit silo where there is no chance of drainage water filtering in. The top of a hillock is an excellent place.

In addition to silage, about 290 maunds of *Raishan* and Soybean hay was made and fed to the cattle and sheep during the winter.

This year about 15 acres has been sown with maize for silage. The crop is not doing so well as usual owing to the unfavourable season. About 25 acres has been sown with *Raishan*, five acres with Soybeans, and two acres with Soybeans and *Raishan* mixed for hay. About half of this, sown on newly-reclaimed land, is not doing well.

Cattle breeding.

18. The following table shows the number of cattle in the herd on 30th June 1913 :—

—	Patna.	Bhutia.	P × B.	P × B × P.	P × Khasi.	P × K. × P.	Total.	Remarks.
1	2	3	4	5	6	7	8	9
Breeding bulls ...	2	...	...	...	...	...	2	
Bulls (3 years and above)	1	...	...	...	2*	6	9	* Are being used as plough cattle.
„ (2 to 3 years) ...	3	...	...	1	...	...	4	
„ (1 to 2 years) ...	3	...	...	3	...	...	6	
„ (under 1 year) ...	5	...	1	...	...	...	6	
Heifers (2 to 3 years) ...	2	...	1	1	...	...	4	
„ (1 to 2 „) ...	1	...	...	4	...	...	5	
„ under one year	1	...	...	3	...	...	4	
Cows	9	1	5	1	...	...	16	
Total ...	27	1	7	13	2	6	56	

In addition to the above, there are 3 Hindustani and 8 Khasi bullocks. The total number of cattle on the Farm was, therefore, 67. During the year 10 animals were born, *viz.*:—

5 Patna bull calves.
1 Patna × Bhutia bull calf.
1 Patna heifer calf.
3 Patna × Bhutia × Patna heifer calves.

There were 5 deaths, *viz.*:—

1 Patna bull calf.
1 Patna × Bhutia bull calf.
3 Patna heifer calves.

Twenty-three animals were sold during the year, *viz.*:—

Patna bulls ... { 7 (for breeding purposes).
3 (1—2 years rejected from herd).

Patna × Khasi bulls { 5 (for breeding purposes).
1 (rejected from herd).

Patna × Bhutia bulls 3 (rejected from herd).
Patna × Bhutia × Patna bulls 1 (rejected from herd).
Bhutia cows 2.
Hindustani bullock 1.

The pure bred bulls were sold at Rs. 50 each and the cross bred at Rs. 40 each. Four went to the plains and the remainder were taken by Khasi cultivators.

The rejected bulls were sold locally for a lump sum of Rs. 145. Some were castrated to be trained as work cattle, and others were slaughtered for beef. These were all "weeds" which would never have been any use for breeding purposes.

The two Bhutia cows and the Hindustani bullock were cast for old age. The Bhutia cows fetched Rs. 40 each and the Hindustani bullock Rs. 25.

The sale price of the breeding bulls is obviously much too low, but we have to sell at concession rates in order to make it possible for the small cultivator to purchase. The pure bred 3-year old Patna bulls sent out from the Farm should be worth at least from Rs. 200 to Rs. 300 each to the purchasers, but it is impossible to realize their full value for the above reasons.

Sheep breeding.

19. With the object of improving the local breed of sheep an experiment was commenced in 1909 with a Dumba ram and 5 Khasi ewes. By the 30th June 1910 the flock had increased to 15. In 1911 two more Dumba rams and 45 Khasi ewes were purchased. In June 1912 the total number of sheep was 136. During the year under report 4 Dumba rams and 11 ewes and ewe lambs were imported.

On 30th June 1913 the total number of sheep on the Farm was 171, made up as follows:—

Dumba rams	5
Dumba ewes	10
Khasi ewes	63
Khasi rams	6
Dumba × Khasi rams	4
Dumba × Khasi ewes	17
Dumba × Khasi ram lambs	26
Dumba × Khasi ewe lambs	21
Dumba × Khasi × Dumba rams ...	3
Do. do. do. ewe	1
Do. do. do. ram lambs ...	9
Do. do. do. ewe lambs ...	6
	171

95 lambs were born during the year, *viz.*:—

Dumba × Khasi ram lambs	42
Dumba × Khasi ewe lambs	30
Dumba × Khasi × Dumba ram lambs ...	16
Do. do. ewe lambs	7
	95

There were 56 deaths, *viz.*:—

Khasi ewes	17	(mostly of old age).
Khasi rams	4	
Dumba × Khasi rams ...	2	
Dumba × Khasi ram lambs ...	16	died of cold in November.
Do. ewe lambs ...	9	
Dumba × Khasi ewes ...	4	
Dumba × Khasi × Dumba ram lambs	2	died of cold.
Dumba × Khasi × Dumba ewe lambs	1	
Dumba ewe	1	
	56	

The following were sold to Khasi cultivators:—

Dumba × Khasi rams 4 @ Rs. 8 each.
Dumba × Khasi ♂ Dumba rams 2 @ Rs. 10 each.

The mortality was heavy. Out of 95 lambs born, 28 died. The majority of deaths occurred in November on a cold wet day. The young cross bred lambs can stand the cold, but a wet day in the cold weather is fatal to the weaker ones, unless they can be brought under shelter before it starts to rain.

The 17 Khasi ewes which died were all very old and their deaths were not unexpected.

In former years most of the cattle and sheep were sent down to Sumer (elevation about 2,000 feet) during the winter for grazing. Last winter, for reasons stated in last year's report, this practice was discontinued, and all the farm stock were kept at the farm throughout the winter.

The experiment was entirely successful, both cattle and sheep being in better condition at the end of last winter than ever before. This was due to the ample supply of silage and hay available at the farm last season.

Establishment.

20. The establishment consists of a Farm Superintendent on Rs. 100—10—200, a Fieldman clerk on Rs. 50, a mali on Rs. 12 and a peon on Rs. 9 per mensem.

There are three apprentices under practical training on Rs. 15 per mensem. One of these is a Lushai boy who has been sent for training by the Superintendent of the Lushai Hills.

There is also an Overseer on Rs. 40, but he is employed almost entirely in supervising the demonstration work in the Khasi and Jaintia Hills district. To assist him in this work three demonstrators on Rs. 25 per mensem are employed. These demonstrators received two years' practical training on the farm as apprentices.

Mr. Herrick Singh continued to act as Farm Superintendent. Babu Rukhmini Mohan De acted as Fieldman clerk until May when he was appointed Superintendent of the new Experiment Station at Karimganj (Sylhet), and Mr. Lewis Reade was appointed in his place.

Two apprentices, one a Khasi and the other a Lushai, completed their two-year course of practical training during the year. The Khasi (U Millison)has since been appointed temporary demonstrator on Rs. 25 per mensem.

The staff worked well during the year. Mr. Herrick Singh and his brother Mr. Harry Singh both did good work, the former in carrying out the experimental work on the Farm and the latter in supervising the demonstration work in the district.

Receipts and expenditure.

21. The total receipts were Rs. 3,889, of which Rs. 567 was by sale of milk, Rs. 940 by sale of cattle and Rs. 812 by sale of potatoes. Of the balance, Rs. 440 was by sale of bonemeal, and this should be deducted from the Farm receipts, leaving a total of Rs. 3,449.

The expenditure amounted to Rs. 20,600. This includes Rs. 2,518 for establishment and Rs. 5,703 for capital charges (mainly construction of quarters and reclamation).

The cost of cattle and sheep breeding was as follows:—

	Rs.
Purchased foods	4,778
Value of Farm produce fed	641
Wages of attendants	2,040
Miscellaneous	103
Total ...	7,562

The total expenditure this year was unusually high owing to the large amount spent on buildings and reclamation.

The most expensive item is undoubtedly the cost of the cattle and sheep breeding operations, and I am not satisfied that the figures given (Rs. 7,562) adequately represent the whole cost. The large amount spent on petty repairs (about Rs. 1,000) was mostly on account of the cattle and this has not been included. Again the greater part of the amount spent (about Rs. 1,708) on reclamation was on account of the cattle, owing to the necessity of extending the cultivated area for the growth of fodder crops. Then again there is the cost of experimenting with fodder crops.

We may take it that the actual recurring cost of the cattle and sheep is from Rs. 8,000 to Rs. 9,000 per annum.

The result of this expenditure is the distribution of about 10 or 12 breeding bulls and perhaps a dozen or so rams annually. Of course the amount of good done cannot be measured by the actual money value of the animals sold, yet it would probably be well to consider whether it is worth while maintaining the held at such great expense.

Practically the only other work of any very great importance being carried out on the Farm at present is the growing of potatoes, and this is probably of much more value than the cattle and sheep breeding operations.

The manure obtained from the cattle and sheep is largely used for potato growing, and when considering the question of the cost of the up-keep of the herd, this important point should not be overlooked. If the herd was abolished we should find great difficulty in obtaining sufficient cowdung for the potato crop, and for this reason, in addition to the good done by improving local stock, there appears to be a good case for maintaining the herd for the present at any rate.

A. G. BIRT,

Deputy Director of Agriculture, Assam.

Shillong,
The 10th September 1913.

REPORT OF THE FRUIT EXPERIMENT STATION, SHILLONG, FOR THE YEAR ENDING ON THE 30TH JUNE 1913.

Introductory.

1. Land of the unclassed State forest situated on the south side of the Jowai road was selected in July 1912 for the site of the fruit garden. Its elevation is about 5,100 feet, distant about a mile from the town. It comprises an area of 35·6 acres, of which 15 to 20 acres is suitable for fruit planting. Work commenced in October 1912. A block of 5 acres of the forest on the lowest level was selected for the first year's planting and has been fenced with Page's wire fencing. Of this area, the soil on about 3½ acres was found of suitable nature for planting. The soil varies from light sandy loam lying above stone to a heavier loam of good depth. The varieties planted were selected to, as far as possible, suit the soil they were to be planted in, but some may have to be transplanted if they do not thrive in their present position. Virgin soil in a pine forest would doubtless benefit by being left exposed for some time after clearing before planting, but the deep trenching done and application of lime greatly improved it. The young trees are healthy and are beginning to put on a good growth. Atmosphere has as much to do with the results as has the soil, and success cannot be looked for in Shillong until it is known what varieties will thrive. An experimental planted area of 10 acres will be necessary for this purpose. Insects, blights and the diseases fruit trees are attacked with, can be contended with. From the 5 years' experience of fruit growing I have had in Shillong, I consider that rabbits, birds, wasps and similar pests that other countries have to contend against, would give as much trouble as do the beetles and flies, the chief enemies of fruit trees in Shillong. Blights and diseases are no worse than in other countries, and if fought against from the commencement by spraying can be overcome. Certain properties where wanted will have to be added to the soil. The experiments made with Superphosphate of Lime, Sulphate of Potash and Sulphate of Ammonia will be carefully watched. The fruit trees were purchased from Messrs. Thomas Rivers & Sons, Sawbridgeworth, Herts, and Messrs. Stuart Low & Company, Bush Hill Park, Middlesex. Messrs. Rivers' first consignment was despatched on the 12th

November 1912 and arrived at Shillong on the 21st January 1913. There was delay in getting delivery at the docks in Calcutta. The pear, cherry and peach trees suffered most, and in consequence have been considerably set back—98 per cent. of the trees have recovered. Messrs. Stuart Low & Company's consignment despatched on the 19th December 1912 arrived in very good condition on the 8th February 1913. A second small consignment from Messrs. Rivers despatched 26th February 1913 arrived on the 1st May 1913; the delay of a week at the London Docks unfortunately gave a severe check to the trees. Six cherry and six peach trees arrived dead; the majority of the rest of the trees survived and have been planted out. Planting commenced on the 27th January 1913 and was finished on the 8th May 1913. The bush and pyramid trees have been planted 15ft. × 15ft. diagonally, the upright trained trees 7ft. apart and the single cordon trees 2ft. apart at an angle of 60°. The standard and horizontal trained apple trees and the orange and lemon trees have been planted in suitable situations.

2. The following statement shows the number and varieties of fruit trees planted :—

Varieties planted.

Species of Fruit trees.	Variety.	Whence obtained.		Total number.	Description.
		Messrs. Thomas Rivers and Sons, Herts.	Messrs. Stuart Low & Co., Middlesex.		
Apple trees	Lady Sudeley ...	6	...	6	Bush.
Ditto ...	Bismarck ...	6	...	6	"
Ditto ...	Sturmer Pippin ...	5	4	9	"
Ditto ...	Warners King ...	12	...	12	"
Ditto ...	Potts Seedlings ...	6	4	10	"
Ditto ...	Alfriston ...	6	4	10	"
Ditto ...	Scarlet Nonpareil ...	12	4	16	"
Ditto ...	Newton Wonder ...	6	4	10	"
Ditto ...	Norfolk Beauty ...	6	4	10	"
Ditto ...	Lanes Prince Albert ...	6	4	10	"
Ditto ...	Juneating (Red) ...	6	4	10	"
Ditto ...	Bens Red ...	5	4	9	"
Ditto ...	Coe's Golden drop ...	6	...	6	"
Ditto ...	Kerry Pippin ...	6	4	10	"

Species of Fruit trees.	Variety.	Whence obtained.		Total number.	Description.
		Messrs. Thomas Rivers and Sons, Herts.	Messrs. Stuart Low & Co., Middlesex.		
Apple trees	Golden Reinette ...	6	...	6	Bush.
Ditto ...	Bramley's Seedlings ...	10	4	14	,,
Ditto ...	Fearns Pippin ...	6	...	6	,,
Ditto ...	Devonshire Quarrenden ...	12	6	18	,,
Ditto ...	James Grieve ...	36	12	48	,,
Ditto ...	Peasgood Nonesuch ...	6	...	6	,,
Ditto ...	Yellow Ingestre ...	6	...	6	,,
Ditto ...	Roundway Magnum Bonum	6	...	6	,,
Ditto ...	Grimson Bramley ...	...	5	5	,,
Ditto ...	Ardcairn Russet ...	...	5	5	,,
Ditto ...	Rev. W. Wilks ...	..	6	6	,,
Ditto ...	William Crump ...	...	6	6	,,
Ditto ...	Hounslow Wonder ...	...	6	6	,,
Ditto ...	Red Victoria ...	...	10	10	,,
Ditto ...	Hector McDonald ...	...	10	10	,,
Ditto ...	Herrings Pippin ...	...	1 (Presented)	1	,,
Ditto ...	Ellison Orange ...	...	1 (Presented)	1	,,
Ditto ...	Charles Eyre ...	...	1 (Presented)	1	,,
Ditto ...	Rymer	8	...	8	Standards
Ditto ...	Stirling Castle ...	5	...	5	,,
Ditto ...	Northern Greening ...	9	...	9	,,
Ditto ...	Scarlet Golden Pippin ...	2	...	2	Upright trained.
Ditto ...	Allington Pippin ...	2	...	2	Ditto.
Ditto ...	Beauty of Bath ...	2	...	2	Ditto.
Ditto ...	James Grieve ...	2	...	2	Ditto.
Ditto ...	Barnack Beauty ...	2	...	2	Ditto.
Ditto ...	King of the Pippins ...	2	...	2	Horizontal trained.
Ditto ...	Coxs Orange Pippin ...	1	...	1	Ditto.
Ditto ...	Kerry Pippin ...	1	...	1	Ditto.
Ditto ...	Claygate Pearmain ...	1	...	1	Ditto.
	Total ...	220	112	332	

Species of Fruit trees.	Variety.	Whence obtained.		Total number.	Description.
		Messrs. Thomas Rivers and Sons, Herts.	Messrs. Stuart Low & Co., Middlesex.		
Pear trees	Emile d' Heyst ...	10	...	10	Pyramid.
Ditto ...	Fondant Thirriot ...	10	...	10	Ditto.
Ditto ...	Madame Treyve ...	10	...	10	Ditto.
Ditto ...	St. Swithins ...	10	...	10	Ditto.
Ditto ...	Clapps Favourite	10	...	10	Ditto.
Ditto ...	Hessle	13	...	13	Ditto.
Ditto ...	Red October ...	10	...	10	Ditto.
Ditto ...	Beurre d' Amanlis ...	10	...	10	Ditto.
Ditto ...	Parrot	10	...	10	Ditto.
Ditto ...	Seedling Bergamot ...	6	...	6	Ditto.
Ditto ...	Josephine de Malines ...	10	...	10	Ditto.
Ditto ...	Dr. Hogg ...	10	...	10	Ditto.
Ditto ...	Fertility	20	...	20	Ditto.
Ditto ...	Beacon	10	...	10	Ditto.
Ditto ...	Durondeau	6	...	6	Ditto.
Ditto ...	Beurre de Naghan ...	...	6	6	Ditto.
Ditto ...	St. Jules Guyot ...	...	6	6	Ditto.
Ditto ...	Roosevelt	...	6	6	Ditto.
Ditto ...	Blickling	...	6	6	Ditto.
Ditto ...	Santa Claus ...	...	6	6	Ditto.
Ditto ...	Precoce de Juillet ...	...	6	6	Ditto.
Ditto ...	Conference ...	3	...	3	Upright trained.
Ditto ...	Marie Louise d' Uccle ...	4	...	4	Ditto.
Ditto ...	Louise Bonne of Jersey ...	4	...	4	Ditto.
Ditto ...	Fondant d' Automne ...	3	...	3	Ditto.
Ditto ...	Conseiller de la Cour ...	3	...	3	Ditto.
Ditto ...	Doyenne du Comice ...	3	...	3	Ditto.
Ditto ...	Louise Bonne of Jersey ...	5	...	5	Single Cordon.
Ditto ...	Conference	5	...	5	Ditto.
Ditto ...	Doyenne du Comice ...	5	...	5	Ditto.
Ditto ...	Williams bon Chretien ...	5	...	5	Ditto.
Ditto ...	Marguerite Marillar ...	5	...	5	Ditto.
Ditto ...	Beurre Superfin ...	5	...	5	Ditto.
Ditto ...	Princess	5	...	5	Ditto.
Ditto ...	Beurre Diel	5	...	5	Ditto.
Ditto ...	Beurre Hardy ...	5	...	5	Ditto.
Ditto ...	Beurre d' Anjou ...	5	...	5	Ditto.
	Total ...	225	36	261	

Species of Fruit trees.	Variety.	Whence obtained.		Total number.	Description.
		Messrs. Thomas Rivers and Sons, Herts.	Messrs. Stuart Low & Co., Middlesex.		
Plum trees	Deniston's Superb Gage ...	10	...	10	Bush.
Ditto ...	Felle de Louvain ...	6	...	6	Ditto.
Ditto ...	Cox's Emperor ...	6	...	6	Ditto.
Ditto ...	Ponds Seedling ...	6	...	6	Ditto.
Ditto ...	Belgian Purple ...	10	...	10	Ditto.
Ditto ...	Early Transparent ...	6	...	6	Ditto.
Ditto ...	Autumn Beauty ...	6	...	6	Ditto.
Ditto ...	Guthries late Gage ...	5	...	5	Ditto.
Ditto ...	Reine Claude de Bavay ...	5	...	5	Ditto.
Ditto ...	Victoria	9	...	9	Ditto.
Ditto ...	Greengage	5	...	5	Ditto.
Ditto ...	Czar	6	...	6	Ditto.
	Total ...	80	...	80	
Peach trees	Peregrine	14	...	14	Ditto.
Ditto ...	Alexander	11	...	11	Ditto.
Ditto ...	Duke of York ...	16	...	16	Ditto.
Ditto ...	Exquisite	4	...	4	Ditto.
	Total ...	45	...	45	
Cherry trees	Morello	3	...	3	Ditto.
Ditto ...	Kentish	24	...	24	Ditto.
Ditto ...	Bigarreau Kentish ...	6	...	6	Ditto.
Ditto ...	Gloire de France ...	6	...	6	Ditto.
Ditto ...	White Heart ...	...	6	6	Ditto.
Ditto ...	Black Heart	...	6	6	Ditto.
	Total ...	39	12	51	
Fig trees	White Marseilles ...	5	...	5	Ditto.
Ditto ...	Bourjassotte Grise ...	5	...	5	Ditto.
Ditto ...	Monaco Bianco ...	6	...	6	Ditto.
	Total ...	16	...	16	

Species of Fruit trees.	Variety.	Whence obtained.		Total number.	Description.
		Messrs. Thomas Rivers and Sons, Herts.	Messrs. Stuart Low & Co., Middlesex.		
Walnut trees.	Dwarf Prolific (Juglans proeparturiens).	10	...	10	Trees.
Lowberries	....	...	6	6	Berries.
Phenomenal	.....	...	1	1	Ditto.
Loganberries	... ...	...	1	1	Ditto.
Orange trees.	St. Michael's Tangierin ...	6	...	6	Trees.
Ditto ...	Jaffa	3	...	3	Ditto.
Ditto ...	Malta Blood	2	...	2	Ditto.
Ditto ...	Silver	3	...	3	Ditto.
Ditto ...	Sustain	1	...	1	Ditto.
Ditto ...	Malta Oval	1	...	1	Ditto.
Ditto ...	Achilles	1	...	1	Ditto.
	Total ...	17	...	17	
Lemon trees	Imperial Lemon ...	2	...	2	Ditto.
Strawberry Plants.	Givons date Prolific ...	...	...	900	Plants.
Ditto	Louis Gauthier ...	...	...	350	Ditto.
	Total ...	...	...	1,250	

SUMMARY OF FRUIT TREES PLANTED—1912-13.

Standard apple trees	22
Bush „ „	295
Upright trained „	10
Horizontal „ „ „	5
Pyramid pear trees	191
Upright trained „	20
Single cordon „	50
Plum trees	80
Peach „	45
Cherry „	51
Fig „	16
Dwarf walnut trees	10
Lowbe ries	6
Phenomenal	1
Logan berries	1
Orange trees	17
Lemon „	2
Strawberry plants	1,250

Manurial experiments.

3. The following experiment with manures have been carried out. The quantities were applied in two dressings at an interval of 6 weeks, in a cricle 4 feet wide round the trees, starting 5 inches from the stem.

James Grieve Apples. 4 rows—5 trees in each row.

Row No.	Manures per tree.
1	6 ozs. Superphosphate.
	4 „ Sulphate of Potash.
	3 „ Sulphate of Ammonia.
2	6 „ Superphosphate.
	3 „ Sulphate of Ammonia.
3	4 „ Sulphate of Potash.
	3 „ Sulphate of Ammonia.
4	No manure.

Clapps Favourite Pear—

No. of plot.	No. of trees	Manures per tree.
1 ...	4 ...	6 ozs. Superphosphate.
		4 „ Sulphate of Potash.
		3 „ Sulphate of Ammonia.
2 ...	3 ...	6 „ Superphosphate.
		3 „ Sulphate of Ammonia.
3 ...	3 ...	No manure.

Fertility Pear—

No. of plot.	No. of trees.	Manures per tree.
4 ...	4 ...	6 ozs. Superphosphate. 4 „ Sulphate of Potash. 3 „ Sulphate of Ammonia.
5 ...	3 ...	6 „ Superphosphate. 4 „ Sulphate of Potash.
6 ...	3 ...	4 „ Sulphate of Potash. 3 „ Sulphate of Ammonia.

Madame Treyve Pear—

No. of plot.	No. of trees.	Manures per tree.
7 ...	4 ...	6 ozs. Superphosphate. 4 „ Sulphate of Potash. 3 „ Sulphate of Ammonia.
8 ...	3 ...	6 „ Superphosphate. 3 „ Sulphate of Ammonia.
9 ...	3 ...	No manure.

Emile Heyst Pear—

No. of plot.	No. of trees.	Manures per tree.
10 ...	4 ...	6 ozs. Superphosphate. 4 „ Sulphate of Potash. 3 „ Sulphate of Ammonia.
11 ...	3 ...	4 „ Sulphate of Potash. 3 „ Sulphate of Ammonia.
12 ...	3 ...	6 „ Superphosphate. 4 „ Sulphate of Potash.

The 29th June 1913.

C. H. HOLDER,

In charge, Fruit Experiment Station, Shillong.

Statement of expenditure of the Fruit Experiment Station, Shillong, from November 1912 *to* 30*th June* 1913.

Head of charges.	Amount.	Remarks.
	Rs. a. p.	
Allowance to Superintendent	1,250 0 0	
Establishment	481 0 5	
Petty construction	2,986 11 9	
Seeds, plants and manures	2,939 10 4	
Instruments, appliances and machinery ...	81 15 3	
Reclamation	70 14 0	
Chemicals insecticide	320 5 9	
Wages of labourers	7,499 2 7	
Other charges	4 2 0	
Total ...	15,633 14 1	

REPORT

ON

AGRICULTURAL DEMONSTRATIONS IN ASSAM

DURING THE YEAR ENDING

JUNE 30TH, 1913.

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1. Demonstrations were carried out in four districts, *viz.*, Khasi and Jaintia Hills, Sibsagar, Sylhet and Kamrup.

In the Khasi and Jaintia Hills U Harry Singh was in charge of the work assisted by three demonstrators. The Agricultural Supervisor held general charge of the demonstrations in the Assam Valley, assisted by the District Agricultural Officer in Kamrup and by two demonstrators in Sibsagar. The District Agricultural Officer of Sylhet was in charge of the demonstrations in that district.

Rice.

2. The advantage of using bonemeal as a manure for wet rice has been successfully demonstrated for several years in the Khasi and Jaintia Hills, the results showing a substantial profit notwithstanding the high price (Rs. 4-8 to Rs. 5 per maund) of bonemeal delivered in the hills. With an application of 3 maunds of raw bonemeal per acre, the increased yield in the first year is usually more than sufficient to pay the cost of the manure, while in the second and third years the increase is nett profit.

The practice of manuring with bonemeal is steadily increasing among the hill people, and this year more than 200 maunds imported from Calcutta was sold to cultivators at from Rs. 4-8 to Rs. 5 per maund. The high price is, however, tending to check the extension of the practice. In view of this and in the absence of local enterprise, we have purchased a small bone-grinding plant, which will be installed shortly at Upper Shillong. Arrangements have been made for the supply of 1,000 maunds of bones, and next season we hope to be in a position to supply bonemeal at about Rs. 3 per maund delivered at Upper Shillong, leaving a small margin of profit as interest on capital.

During the year under report the results of paddy manuring demonstrations are available at two centres only in the Khasi Hills. The total number of manured plots was 19; these were alternated with 19 non-manured plots as a control. The aggregate area of manured plots was 0·6 acre, and of the controls the same.

The following results were obtained :—

	Yield.		Yield per acre.	
	Grain.	Straw.	Grain.	Straw.
1	2	3	4	5
	Mds.	Mds.	Mds	Mds.
Manured plots	13½	15	22½	25
Unmanured	10	11	17½	18
Increase due to manure	...	...	5	6

The increase in grain was a little more than sufficient to cover the cost of the manure. The result on the first crop was quite satisfactory, as bonemeal never exerts its full effect in the first year, and heavier crops from the manured areas may be confidently expected in the second year.

A more extensive scheme of paddy manuring demonstrations was commenced during the year in four districts, Khasi and Jaintia Hills, Sibsagar, Sylhet and Kamrup. In each district 10 centres were selected on cultivators' holdings. Five plots, each approximately one *bigha* (⅓ acre) in area, were taken and treated as follows :—

(1) No manure.
(2) Three maunds bonemeal per acre.
(3) No manure.
(4) Three maunds flour phosphate per acre.
(5) No manure.

In Sylhet and Kamrup the demonstrations are mostly on "do fasl" land, *i.e.*, land from which two crops of paddy, one of *aus* and one of transplanted paddy, are taken annually. In Sibsagar the land is chiefly "ek fasl," only one crop of

transplanted paddy being grown. In the Khasi and Jaintia Hills the land is also "ek fasl," but the crop is broadcasted instead of being transplanted as in the plains.

The first year's results of these demonstrations will not be available until December.

Sugarcane.

3. In the Sibsagar district, demonstractions were carried out at 12 centres. In each case B. 376 cane from the Jorhat Farm was planted alongside the local varieties on cultivators' holdings. In nine centres equal areas of B 376 and the local varieties were taken for comparison, while in the remaining 3 centres, where the crops were badly injured by jackals and monkeys, an equal weight of B376 was compared with equal weights of the local varieties.

The weights of *gur* per acre were as follows :—

—	Centre.	Variety.	*Gur* per acre.—	
1	2	3	4	
			Mds.	srs.
1	Montgaon	B. 376	62	15
		Magh	45	15
2	Nauhalia gaon	B. 376	63	10
		Magh	40	32
3	Kakilamukh	B. 376	59	27
		Magh	48	13
4	Duliagassaingaon ...	B. 376	75	21
		Magh	39	13
		Teli	30	10
		Dibrugarh Pounda ...	72	23
5	Jamuguri	B. 376	46	15
		Magh	22	7
6	Panisukua	B. 376	55	28
		Magh	22	27

—	Centre.	Variety.	*Gur* per acre.	
1	2	3	4	
			Mds.	srs.
7	Basagaon	B 376	49	6
		Magh	20	29
8	Bamungaon	B 376	56	28
		Teli	29	34
9	Bernagaon	B 376	21 24	Planted too late.
		Teli	16 8	

The results obtained by crushing equal weights of B 376 and the local varieties in the remaining three centres were as follows:—

—	Centre.	Variety.	Weight of cane.		Weight of juice.		Weight of *gur*.	
1	2	3	4		5		6	
			Mds.	srs.	Mds.	srs.	Mds.	srs.
10	Panichukua ...	B 376 ...	9	20	6	18	1	10
		Teli	9	20	5	10	0	38
11	Dhuli ...	B 376 ...	9	20	6	25	1	25
		Magh ...	9	20	5	20	0	39
12	Charaibari ...	B 376 ...	10	15	7	0	1	10
		Magh and Teli ...	10	15	6	15	1	0

B 376 shows a marked superiority over the local varieties, Magh and Teli, yielding from 23 per cent. to 150 per cent. more *gur*, and averaging 83 per cent. more for the nine centres.

In No. 4 centre a variety locally known as "Dibrugarh Pounda" was practically as good as B 376. This variety is not generally grown by the Assamese, but is frequently found on the holdings of Nepali and up-country settlers. It was probably introduced by Marwari merchants, of whom there is a large colony at Dibrugarh.

In the crushing tests at centres Nos. 10 to 12, the advantage in favour of B 376 averages about 40 per cent. on the weight of *gur*.

These demonstrations have already begun to take effect, as this year there was a large demand for cuttings of the superior varieties grown at Jorhat, in fact far greater than we were able to meet.

In order to popularize the use of the 3 roller iron crushing mill in place of the old wooden mill still used to a great extent by the Assamese, six iron mills in charge of demonstrators were sent out in the Sibsagar district. One cultivator has since offered to purchase two of the mills and many others have expressed a desire to do so. The chief difficulty appears to be the initial outlay, which is about Rs. 60 for each mill. Most cultivators grow cane on only a very small scale and cannot afford to purchase a mill for their own use. There is apparently a good opening here for Co-operative Credit Societies to advance money for the purchase of mills. Probably the best system for small holders would be for one man to purchase several mills and hire them out to the neighbouring cultivators.

Next year it is proposed to send out at least 12 mills for demonstration purposes in various parts of the district.

Potatoes.

4. The value of the superior varieties of potatoes grown at the Upper Shillong Farm is already recognised by the majority of cultivators in the Khasi Hills, with the result that there is a considerable demand for "seed." To meet this demand considerable areas of two of the best varieties, *viz.*, King of Potatoes and Magnum Bonum were grown at the farm in 1912 and 1913. In 1912 635 maunds of "seed" of these varieties was sold. In 1913, a larger area was grown with the result that about 1,000 maunds of seed is available for sale. This is being sold at market rates at the farm and at four other centres in the hills.

In the Khasi Hills the value of spraying potatoes with Bordeaux mixture as a preventive of the potato disease (*Phytophthora infestans*) has been successfully demonstrated on cultivators' holdings for several years. The chief obstacle to the general adoption of the practice is apparently the cost of the spraying machine. This year, in order to get over this difficulty, we arranged to send out 12 expert sprayers with machines to spray the crops of those cultivators who wished to have it done. It was expected that each machine would deal with about 20 acres of potatoes, but owing to a long drought in the spring the season proved to be a very bad one

for the potato crop, and consequently the majority of the cultivators were unwilling to bear the cost of spraying on crops which to all appearances were already doomed to failure. Consequently only 32 acres were sprayed, and of this area it is reported that on only 9 acres spraying was successful, the crops on the remaining area being too badly affected by the drought to benefit by spraying.

In an average season the profits due to spraying are usually well over 100 per cent. on the expenditure, which is about Rs. 12 to Rs. 13 per acre including cost of materials and labour.

Next year it is proposed to repeat this demonstration when, if the season is favourable, the machines should be fully employed.

Grafting of fruit trees.

5. During the year two demonstrators were sent out to instruct owners of orchards in the art of grafting. They visited numerous villages in the Khasi and Jaintia Hills and made 333 grafts, 138 of which were pears, 4 apples, 93 peaches, 40 oranges, 31 plums and 27 apricots.

Terrace cultivation.

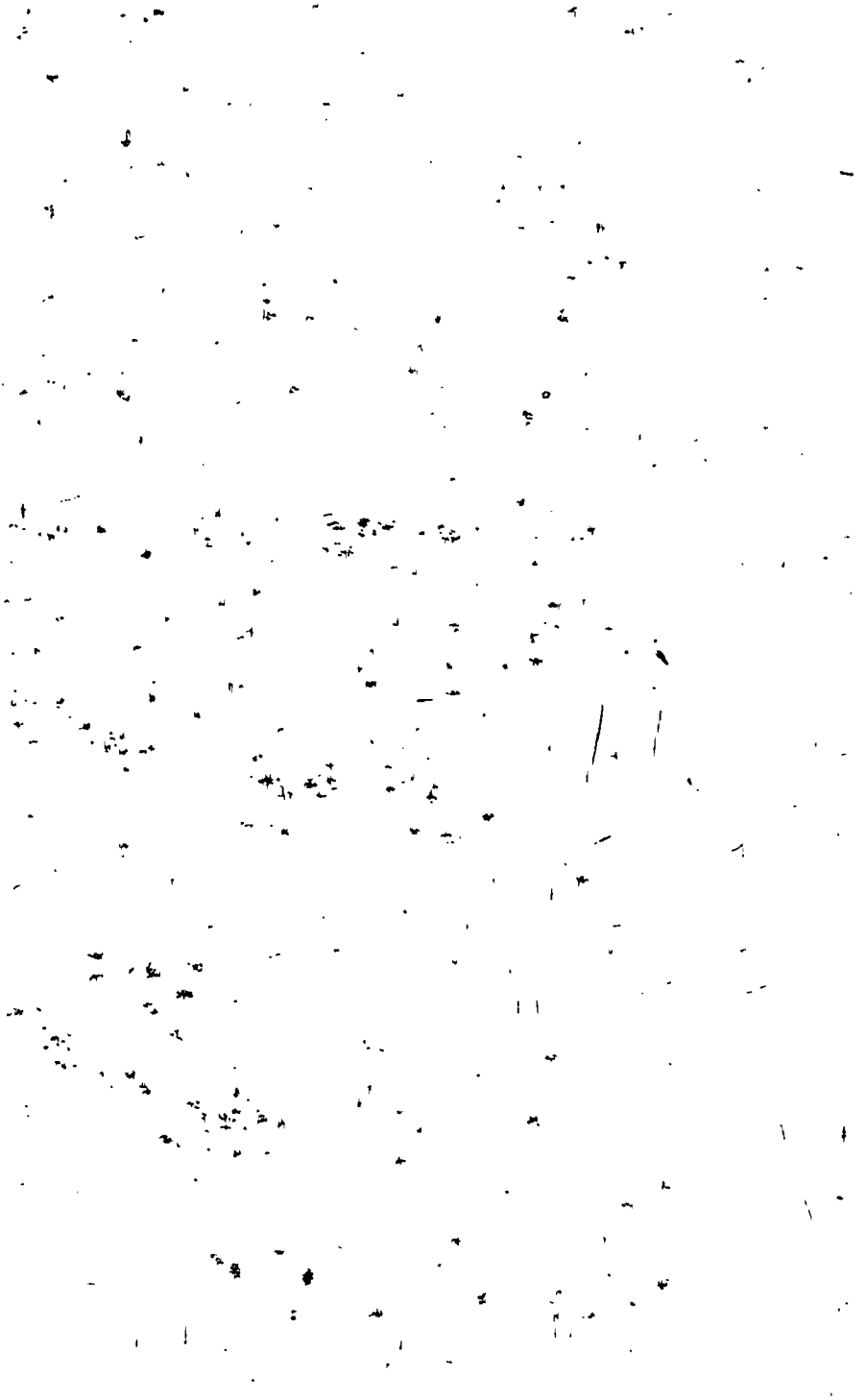
6. In connection with the denudation of the gorges on the southern side of the Khasi and Jaintia Hills caused by excessive "jhuming" of the higher slopes, a site was selected near Maolot village and laid out in terraces with the object of inducing the cultivators to abandon "jhuming" and take up this style of cultivation instead. The area terraced is about half an acre. The crops sown are *raitruh* (a millet), maize and sweet potatoes. It remains to be seen whether this method of cultivation will be successful.

A. G. BIRT,

Deputy Director of Agriculture, Assam.

15*th September* 1913.

A. S. P. O. (D. L. & Agri.) No. 62—520—5-12.1913—A. U. A.



ANNUAL REPORT

ON THE

AGRICULTURAL EXPERIMENTS AND DEMONSTRATIONS

IN

ASSAM

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FOR THE

YEAR ENDING THE 30TH JUNE 1914.

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ANNUAL REPORT OF THE JORHAT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1914.

Introduction.

This station is situated about 3 miles south of Jorhat, Sibsagar district, Assam Valley, and was established in the beginning of the year 1906. It was intended principally for sugarcane work. Since then, on account of peculiar soil conditions which altogether precluded the growth of *rabi* crops even in the presence of abundance of soil moisture, the work has been extended to include a study of the factors causing this sterile condition with a view to its amelioration. This work has been continued for five years, and we are now in a position to state that the sterile condition of the soil to most crops in the cold weather and also to certain crops in the rains is due to the accumulation of acid substances, which are readily neutralised and rendered harmless by dressings of lime to the soil. A full account of the experimental results leading up to this conclusion has been written by Mr. A. A. Meggitt, Agricultural Chemist, and will be published shortly as a memoir of the Department of Agriculture.

In connection with the improvement of the soil by liming, the application of other fertilizers has been studied, and our regular scheme of manuring now includes green manuring and the application of raw phosphates.

The original area of the station was about 35½ acres, of which 1·7 acres is *hola* or ravine land and the remainder high land which was under grass and scrub jungle at the time of acquisition. An additional area of about 24 acres has since been acquired, of which about 4 acres is *hola* land and the remainder high land. The total area at present is thus about 59½ acres. Most of the newly added area has been put under cultivation and is being treated uniformly in blocks with a view to future experiments.

Soil.

2. The soil of the high land is a reddish sandy loam of the old alluvium, lying on a hard greyish yellow sub-soil. Where the conditions have not been improved by cultivation, the soil is extremely shallow, varying from only 3 to 6 inches in depth.

The following report is by Mr. A. A. Meggitt, Agricultural Chemist, Assam :—

Report on analysis of Jorhat farm soil.

	Surface soil.	Sub-soil.
	Laboratory No. 5.	Laboratory No. 5 (a).
1	2	3
Soluble in Hydrochloric acid with 12 hours digestion at 100°c	Per cent.	Per cent.
Phosphoric acid (P_2O_5)	0·025	0·020
Potash (K_2O)	0·115	0·135
Lime (CaO)	0·154	0·144
Magnesia (MgO)	0·166	0·148
Soluble in 1 per cent. citric acid with 7 days digestion.		
Phosphoric acid	0·008	0·008
Potash	0·007	0·011
Loss on ignition (organic matter and combined water).	3·26	1·84
Nitrogen	0·114	0·051
Calcium carbonate	0·048	0·018
Reaction	Acid	Acid

Physical constants.

	Hygroscopic capacity.	Maximum water-saturation capacity		Minimum water-saturation capacity.		Moisture in air dry soil.
		Per cent. of water in saturated soil by weight.	Per cent. of water in saturated soil by volume.	Per cent. of water by weight.	Per cent. of water by volume.	
1	2	3	4	5	6	7
Surface soil ...	3·10	31·9	50·5	11·2	13·9	1·3
Sub-soil ...	...	30·0	50·0	7·2	9·1	0·19

" These analyses agree quite well generally with some others made some years ago by the Imperial Agricultural Chemist.

These samples are acid in reaction, and the total lime present in all combinations, as well as the carbonate of lime, is quite deficient in quantity.

Carbonate of lime has an enormous influence on a soil's welfare chemically, physically, and bacteriologically.

Its effect on soil biological processes are in the right direction, and very great ; it also influences the texture of soils in a remarkable way, and is active in bringing into use the reserves of dormant plant food. Its presence in fair amount also ensures the most economical effect of any manuring given. Its absence forbids the use, for most cropping, of certain kinds of manures, unless it be first resorted to.

Any upland soil containing such small amounts of total lime and lime carbonate as are here present will most certainly respond markedly in the case of most cropping to applications of lime.

The amount of organic matter is probably greater than obtains in many Indian soils, but there is no doubt that a light soil of this character will be much improved in many ways by an increase in the amount of humus.

"A good deal of the organic matter present is of a doubtful character and consists very probably of very old residues of little value; it is the presence and active decay of comparatively recent additions of organic matter which puts life into a soil.

The percentage of nitrogen present in the surface soil is what would normally be considered a fair one, but in view of the absence in anything like adequate quantity of carbonate of lime, conditions for nitrification are probably not as favourable as they might be by a long way, and an increase in the amount of nitrogen is indicated as desirable.

Of potash there is no dearth, and there would seem to be no immediate need for potash manuring.

Regarding phosphoric acid, these samples show a deficiency both in total as well as available supplies. There is thus a "real" as opposed to a mere temporary lack in respect of this element of plant food.

This lack of phosphoric acid is further aggravated by the absence of sufficiently large amounts of lime carbonate and humus, high percentages of which may, and often do offset a smaller percentage of phosphoric acid.

An acid condition of soil, besides being harmful in itself very often brings about a more rapid depletion of the soil's stock of phosphoric acid, in consequence of which most soils of a decidedly acid character are found to be lacking in this element, and to respond to its suitable application.

Turning to the physical constants, the hygroscopic capacity is low, and about what one would expect for this class of soil. It means that only water which is in excess of about 3 per cent. is available for crops, and plants, are able to reduce the soil moisture content to somewhere about this figure before they begin to wilt. The top 6 inches of soil even during the cold weather normally contains a good deal more moisture than 3 per cent. when under a close standing crop, so that usually there is sufficient water for the crop's requirements.

As regards maximum saturation capacity, these soils agree quite well with quoted figures for similar soils in Europe, and suggest that the optimum proportion of water for the growth of the plant is about 13·16 per cent. A recent determination of soil moisture in the surface 6 inches of the soil of this farm

in August some few hours after rain gave 17 per cent. water. Soil moisture conditions are therefore probably extremely favourable for growth during the rainy season.

The figures for minimum saturation capacity are much lower than those cited (Hall, The Soil, page 69) for similar soils in Europe, and this probably due to the lower content of humus which obtains in our soils. This is an extremely important figure in gauging a soil's power to retain a reserve of moisture for crops during dry periods.

The sub-soil is worse in this respect than the surface layer, suggesting that the incorporation of organic matter, if it can be buried sufficiently deep, will have a great ameliorating effect indeed.

The sub-soil is capable of very great improvement indeed as the figures show, but it would probably be immediately disastrous to work it so deeply as to bring any considerable amount to the surface at once.

The growth of deep-rooting legumes as green crops will assist materially, but if the sub-soil could be stirred occasionally, while at the same time the surface cultivation is gradually deepened so that green crops may be more deeply buried, a greater depth of surface soil will result, which on this farm is very much to be desired.

I am convinced that for cane cultivation, until the surface soil has been deepened and the amount of humus increased, it is of little use attempting manurial experiments on cane with artificial manures. No amount or combination of the latter can ever make up in the case of a crop like sugarcane for loss of fertility due to shallow cultivation and lack of humus."

Buildings and machinery, etc.

3. The farm is equipped with a godown, combined office and rest-house, quarters for Farm Superintendent, Fieldman clerk and apprentices, and a cattle shed with brick walls and corrugated iron roof. A three roller 12″ × 18″ cane mill driven by a 9 B. H. P., Hornsby oil engine was installed in 1911.

During the year a pucca culvert was built over the *hola* between the old and new areas at a cost of Rs. 510, and Ideal wire fencing was purchased at a cost of Rs. 1,895 including freight.

4. The rainfall recorded during the growth of the crops referred to is given in the following table together with the normal rainfall :—

Rainfall.

Month.		Actual rainfall in inches.	Normal rainfall in inches.
1		2	3
1913	April	20·47	8·54
„	May	7·34	9·26
„	June	8·38	11·36
„	July	13·49	14·76
„	August	8·54	15·15
„	September	12·32	9·18
„	October	8·11	4·07
„	November	0·22	0·69
„	December	3·53	0·52
1914	January	0·84	0·93
„	February	2·42	1·32
„	March	0·34	3·90
	Total ...	86·00	79·68
„	April	5·67	8·54

The rainfall was ample, and a little above the average. The cold weather set in rather early and was more foggy than usual thus shortening the growing season for the sugarcane. Otherwise the season was normal.

Experimental work.

5. This mainly consisted of continuing, and in some cases extending the work of previous years under the following heads :—

I.—Sugarcane experiments.

II.—Soil investigations.

III.—Trials of new crops.

Sugarcane.

6. In previous years as a rule, in all experiments with this crop the whole produce of each plot has been weighed and, after crushing, samples have been taken from the juice in bulk. This year owing to the facts stated below it was impossible to do this, so only about 20 maunds (1,600 lb.) of cane of each variety were crushed and the juice sampled. Subsequently the whole of each plot was harvested and weighed, and the figures per acre shown in Tables I to VII are calculated from the results of the analysis of the 1,600 lb. sample of cane, in conjunction with the actual weight of cane from the whole of each plot.

The reason for this departure from our usual practice was that large quantities of our best varieties of cane were required for planting near the site of the proposed sugarcane growing experiment in Kamrup, and a great deal of this had to be provided from the experimental plots. In all over 60 tons of cane was despatched to Kamrup during the crushing season. This involved the farm staff in a good deal of extra work, as the cane had to be made into convenient sized bundles of from 80 to 100 lb. weight, wrapped round with thatching grass, and carted over 10 miles to the railway. Some 1,315 bundles in eleven consignments were packed and forwarded in this way between February 23rd and April 10th.

Sugarcane Varieties Ratoon cane.

7. The following varieties planted in Block A in 1912, were ratooned :—

B. 147	¼ acre duplicate plots.
B. 376	
Striped Mauritius ...	
B. 208	1/20 acre plots.
Yellow Tana ...	
Magh	
Kheri	

The results of the first crop were given in last year's annual report. After harvesting the crop of plant cane in March 1913 the trash was spread over the field and burnt, and all pieces of diseased cane which escaped burning were collected and destroyed. Subsequently the land was hoed. A dressing of 10 maunds of rape cake per acre was applied and the cane was partially earthed in the beginning of June. At the end of June a light hoeing was given, and in the second week of July another 10 maunds of rape cake per acre was applied and the cane was given a final earthing. Stripping was done in October.

The cane was harvested in March 1914. As usual, Magh, the local variety, failed to produce a ratoon crop worth harvesting. The results of the other varieties, with the exception of Striped Mauritius which, in the hurry of sending cane to Kamrup, was not sampled, are given in Tables I and II.

TABLE I.

RATOON CANE, 1913-14.

Juice.

Serial No.	Variety.	Area of plot.	Cane, sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity coefficient.	Remarks.
1	2	3	4	5	6	7	8	9	10
			Per cent.	Per cent.	Per cent.		Per cent.		
1	B. 147 (plot 1)	¼ acre	16·11	0·60	16·71	3·75	17·55	91·8	
2	B. 147 (plot 4)	„	17·14	0·43	17·57	2·50	18·40	93·1	
3	B. 376 (plot 2)	„	14·86	0·79	15·65	5·33	16·35	90·8	Badly lodged.
4	B. 376 (plot 5)	„	15·67	0·56	16·23	3·60	16·90	92·7	Ditto.
5	B. 208	$\frac{1}{10}$ acre	17·86	0·33	18·19	1·87	19·00	94·0	
6	Yellow Tana	„	15·34	0·74	16·08	4·85	17·30	88·6	Albuminoids in juice high. Difficult of defecation.
7	Magh			No crop worth harvesting.					
8	Kheri	„	11·67	1·67	13·34	14·36	14·55	80·2	

TABLE II.

Ratoon Cane, 1913-14.

Figures are per acre.

Serial No.	Variety.	Cane.	Juice.	Juice on cane.	Total sugar in juice.	Total sugar in juice.	Total cane sugar (sucrose) in juice.	Remarks.
1	2	3	4	5	6	7	8	9
		lbs.	lbs.	Per cent.	Per cent.	lbs.	lbs.	
1	B. 147 (plot 1)	38,704	24,150	62·40	16·71	4,036	3,891	These two plots and especially plot I were badly injured last year by a violent storm which laid the plant cane and injured the stools. This accounts for the comparatively poor ratoon yield.
2	B. 147 (plot 4)	45,508	28,420	62·45	17·57	4,993	4,871	
3	B. 376 (plot 2)	55,824	36,145	64·75	15·65	5,656	5,371	
4	B. 376 (plot 5)	55,676	35,600	63·95	16·23	5,778	5,578	
5	B. 208	44,800	26,520	59·20	18·19	4,824	4,736	
6	Yellow Tana	62,800	36,240	57·70	16·08	5,827	5,560	
7	Magh	No crop worth harvesting						
8	Kheri	62,320	32,700	52·50	13·34	4,362	3,816	

The yields of ratoon cane are considerably less this year than last. In assigning a reason for this state of affairs the following facts must be taken into consideration :—

(1) That the land of this Block (A) is amongst the worst of the farm. In 1909, when it was under plant cane the crop practically failed in spite of heavy manuring, while in 1910, the ratoon crop was little more than half that of this year.

(2) That owing to the treatment, *viz.*, liming, green manuring, etc., which this block received from 1910-12 it carried a very heavy crop of plant cane last year which would have the effect of exhausting the soil for the succeeding ratoon crop.

(3) That the cold weather of 1913-14 set in exceptionally early and there was more fog than usual.

It would appear that our usual dressing of 20 maunds of rape cake per acre is not sufficient on this class of land for a ratoon crop following on a heavy plant cane crop, so this year we have raised the amount of cake to 30 maunds per acre for the ratoons (about 120lb N per acre).

With regard to quality, B 376 and B 147 are about the same as last year while B 208 shows a very marked improvement.

Sugarcane Varieties. Plant cane.

8. The following varieties were grown on Block D :—

B. 147		
Striped Mauritius	¼ acre duplicate plots.	
B. 376.		
Magh		
	1/10 acre plots.	
B. 208		

Kheri and Tana were planted on small non-experimental areas, and Bogapura and Gendari (Dacca), which were rejected as failures some years ago, were re-introduced on small areas with the object of testing whether under the improved condition of the soil they will be more successful. These varieties have now been planted on experimental plots and the results will be recorded next year.

Block D was under plant cane in 1909-10 followed by ratoon in 1910-11. In March 1911, after the ratoon crop was harvested, a dressing of 25 maunds of slaked lime per acre was applied. Then a crop of *ahu* paddy was sown followed by a crop of matikalai (phaseolus radiata) in the cold weather. In March 1912, another dressing of slaked lime was applied at the rate of 5 maunds per acre, bringing up the total lime dressing to 30 maunds per acre. In 1912, a crop of cowpeas was grown for green manure, and sugarcane was planted in the spring of 1913.

The sugarcane cuttings were planted direct in the field in rows four feet apart, as against the usual practice in previous years when the cuttings were sprouted in a nursery and planted in rows three feet apart. The manuring also in the case of plots 4 to 6 differed from our usual method of treating plant, cane, in that oilcake was substituted for half the usual amount of cowdung in three plots thus:—

Plots 1 to 3—Per acre	200	maunds cowdung	at planting time.
Ditto	150	ditto	„ first earthing.
Ditto	150	ditto	„ second „
Total ...	500	maunds.	

Plots 4 to 6—Per acre	200	maunds cowdung at planting time.
Ditto	25	ditto and 5 maunds and 35 seers cake at first earthing.
Ditto	25	maunds cowdung and 5 maunds 35 seers cake, second earthing.
Total ...	250	maunds cowdung $11\frac{3}{4}$ maunds cake.

The cowdung was valued at $1\frac{1}{2}$ annas per maund and the cake at Rs. 2 per maund, the money value of 250 maunds of cowdung being supplied as cake in plots 4 to 6.

A few reserve sets were kept in a nursery with which to fill up blanks in the plots, but germination was good and there were very few blanks to fill.

The cane was planted in the first week of March 1913. Weeding and first earthing was done in the middle of April, and final earthing and manuring in the beginning of July. The cane was Stripped in November and harvested during the latter half of March 1914. The results are given in Tables III and IV:—

TABLE III.

PLANT CANE, 1913-14.

Juice.

Plot.	Variety.	Plot area.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity coefficient.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre.	Per cent.	Per cent.	Per cent.		Per cent.		
1	B. 147	½	16·55	0·50	17·05	3·03	18·1	91·4	
2	Striped Mauritius ...	½	16·68	0·44	17·12	2·65	17·9	93·2	
3	B. 376	½	16·76	0·28	17·04	1·65	17·8	94·1	
4	B. 147	½	17·24	0·40	17·64	2·35	18·6	93·0	
5	Striped Mauritius ...	½	16·94	0·42	17·36	2·49	18·1	93·9	
6	B. 376	½	16·83	0·29	17·12	1·73	17·7	95·0	
7	Magh	$\frac{1}{10}$	14·61	0·68	15·29	4·64	16·7	87·7	
8	B. 208	$\frac{1}{10}$	18·30	0·54	18·84	2·93	19·6	93·6	

TABLE IV.

PLANT CANE, 1913-14.

(Figures are per acre.)

Plot.	Variety.	Plot area.	Cane.	Juice.	Juice on cane.	Total sugar in juice.	Total sugar in juice.	Cane sugar (sucrose) in juice.	Remarks.
1	2	3	4	5	6	7	8	9	10
			lbs.	lbs.	Per cent.	Per cent.	lbs.	lbs.	
1	B. 147	½ acre	65,296	46,569	71·32	17·05	7,940	7,707	
2	Striped Mauritius ...	½ „	69,060	43,580	63·11	17·12	7,462	7,270	
3	B. 376	½ „	59,450	34,670*	58·32*	17·04	5,908*	5,811*	* These figures are much too low and cannot be accepted as accurate. See same variety on plot 6.
4	B. 147	½ „	62,608	40,470	64·64	17·64	7,139	6,977	
5	Striped Mauritius ...	½ „	62,760	44,230	70·48	17·36	7,679	7,493	
6	B. 376	½ „	62,016	45,395	73·20	17·12	7,771	7,640	
7	Magh	$\frac{1}{10}$ „	59,540	38,440	64·56	15·29	5,878	5,616	
8	B. 208	$\frac{1}{10}$ „	57,080	36,800	64·47	18·84	6,933	6,735	

With the exception of Magh, which is about the same as last year, the yields of total sugar per acre although high are about 1,000 lbs. less than those of the plant cane last year. This is partly due to the effect of the season which, as remarked before, was unusually cold and foggy, and also to the fact that the numbers of sets per acre were largely reduced owing to spacing the rows 4 feet apart instead of 3 feet. With 4 feet spacing of rows, a larger number of sets per row is required to produce a full crop.

On the other hand the results obtained this year are very superior to those obtained on the same land in 1909-10, as will be seen from the following figures:

	Sugar per acre.		
	1909-10.	1913-14.	
	Lbs.	Lbs.	
Striped Mauritius ...	5,379	7,570	average of 2 plots.
B. 147 ...	2,648	7,539	ditto.
B. 376 ...	2,102	7,771	1 plot.

This improvement can only be ascribed to the treatment of the land during 1911-12 when, in addition to thorough cultivation, it was given a dressing of 30 maunds of lime per acre and green manured. This bears out our experience in the case of Block A last year, where the cane crop more than doubled itself since the last rotation (*vide* Jorhat Farm Report for year ending June 30th, 1913).

With regard to quality, the juice is very similar to that of last year's plant cane, the three Barbadoes varieties and Striped Mauritius maintaining their position as producers of high purity juices.

Examining the yield figures from the point of view of the differential manurial treatment, and neglecting both plots of B 376 since the figure for plot 3 is probably erroneous, we find that the cowdung-only plots give an average yield of 7,539 lbs. sugar per acre against 7,409 lbs. for the cowdung *plus* oilcake plots. The difference is very small and is well within the bounds of experimental error, so apparently when cowdung is scarce oilcake may be used advantageously as a substitute. It is probably unnecessary to point out that a very great deal depends on the quality of the cowdung and oilcake used. An average sample of cowdung made in a pit may be taken to contain 0·5 per cent. nitrogen, and rapecake 5 to 6 per cent. nitrogen.

This experiment is being repeated during the current year.

9. This was laid down in Block A in 1912. There are three plots each $\frac{1}{8}$th acre in area, the distance between the rows being 3, 4, and 5 feet respectively. The same number of sets was planted in each row. The variety planted was B 376 in all plots. Cultivation and manuring was the same as in the ratoon variety experiments. The results are given in table V.

Sugarcane planting experiment. Ratoon.

TABLE V.

Planting Experiment—Ratoon Cane, 1913-14.—*B376*—$\frac{1}{8}$ *acre plots.*

Plot No.	Area of plot.	Number of rows.	Width apart of rows.	Sets per row.	Sets per acre.	Weight of cane per row.	Weight of cane per acre.	Remarks.
1	2	3	4	5	6	7	8	9
					Acre.	Lbs.	Lbs.	
1	$\frac{1}{8}$th acre...	20	3 feet	45	7,200	330	52,800	Each row had same number of sets. Distance between rows and hence number of sets per acre were the only variants.
2	$\frac{1}{8}$th „ ...	15	4 „	45	5,400	471	56,528	
3	$\frac{1}{8}$th „ ...	12	5 „	45	4,320	594	57,072	

As in last years' plant cane so in the ratoon the variation in the composition of the juice of the 3 plots was negligible. Apparently the number of sets per acre within reason below about 10,000 has very little or no effect on the quality of the juice. All our planting experiments up to date point to this.

With regard to yield per acre, wider planting has come out best in the ratoon, while last year in the case of the plant cane of which this is the ratoon, the reverse was the case; but this needs further confirmation.

10. This was set out in Block D in 1913. There are 4 plots each $\frac{1}{10}$th acre in area. The experiment is very similar to the one laid down last year, differing from that only in so far as the three feet planting has been climinated and two varieties have been used instead of one.

Sugarcane planting experiment. Plant cane.

Cultivation was the same as for the variety experiments in the same block. Manuring was 500 mds. cowdung per acre, 200 mds. being applied in the rows at planting time and the remainder in two equal doses at the times of earthing.

The results are given in Tables VI and VII :—

TABLE VI.

Plant Cane.—Planting Experiment, 1913-14.

Variety.	Plot area.	Number of rows.	Width apart of rows.	Number of sets per acre.	Weight of cane per row.	Weight of cane per acre.	Remarks.
1	2	3	4	5	6	7	8
			Ft.	Acre.	Lbs.	Lbs.	
B. 376	$\frac{1}{10}$th acre ...	10	4	5,400	712	71,230	Each row had same number of sets. Distance between rows, and hence number of sets per acre were the only variants.
	$\frac{1}{10}$th „ ...	8	5	4,320	737	58,930	
B. 147	$\frac{1}{10}$th „ ...	10	4	5,400	606	60,580	
	$\frac{1}{10}$th „ ...	8	5	4,320	816	49,310	

TABLE VII.

Plant Cane.—Planting Experiment, 1913-14.

Variety.	Width apart of rows	Cane per acre.	Juic pe r acre.	Juice on cane.	Cane sugar in juice.	Invert sugar in juice.	Total sugar in juice.	Glucose ratio.	Total solids in juice.	Purity co-efficient.	Total sugar per acre.
1	2	3	4	5	6	7	8	9	10	11	12
	Ft.	Lbs.	Lbs.	Per cent.	Per cent.	Per cent.	Per cent.		Per cent.		Lbs.
B. 376 ...	4	71,220	46,750	65·64	17·71	0·24	17·95	1·35	18·75	94·4	8,392
	5	58,030	38,320	65·03	16·42	0·40	16·82*	2·43	17·64	93·1	6,446
B. 147 ...	4	60,580	38,390	63·37	17·47	0·42	17·89	2·39	18·93	92·3	6,868
	5	49,310	31,018	64·73	17·63	0·41	18·04	2·34	19·04	92·6	5,753

*This plot was lodged and attacked by parrots. This probably accounts for reduction in quality of juice.

As regards quality of juice, leaving out of account B 376 one plot of which was lodged and attacked by birds, these results confirm the previous year's plant cane results, and also those of this year's ratoon crop, *viz.*, that the number of sets per acre does not affect the quality of the cane.

On the other hand the weight of cane per acre is increased where the larger number of sets is used, thus agreeing with last year's plant cane results.

This year we have laid down a more comprehensive experiment with the object of ascertaining the optimum number of sets for 4 feet and 5 feet spacing of rows respectively, and the results will be given in next year's report.

Soil investigations.

11. This work, which has been fully described in the last two annual reports* of this farm, was continued and extended during the year under report. This year it is proposed to treat the subject very briefly, and to confine remarks chiefly to the results obtained in 1913-14. When sufficient material has been collected, a bulletin will be issued describing the results of the several years' work in full.

The investigations were commenced in 1909 and now consist of the following experiments :—

Block G.—Liming experiment laid down in 1909.

Block C.—Liming and manurial experiment; also wood ashes experiment laid down in 1911.

Block K.—Experiment to ascertain the reasons for the observed remarkable affect of lime on this soil, laid down by Mr. Meggitt in 1912.

Block L. (new area).—Limestone experiment laid down in 1913.

Block E.—Experiment with flour phosphate laid down in 1913.

The results of the experiment on Block K have been written up by Mr. Meggitt and will be published shortly as a Memoir of the Department. This year's results of the remaining experiments will be dealt with in the following paragraphs.

Liming experiment.

12. *Block G.*—Slaked lime at the rate of 50 mds. (4,100 lbs.) per acre was applied to half the area in 1909. The limed area was divided into two equal parts longitudinally in 1911, and 6 mds. (492 lbs.) bone meal per acre applied to one part. In 1913 the

* Annual reports of the Jorhat Experiment station for the years ending June 30th 1912 and 1913.

whole area including the non-limed plot was given a dressing of 100 mds. (8,200 lbs.) cowdung per acre. *Aus* paddy has been sown annually on the whole area followed by representative crops in the cold weather. The cold wheather crops were sown in strips across both treated and untreated plots. Usually the *aus* paddy yields a moderate crop on all the plots, being rather better on the limed plots. The cold weather crops on the other hand fail altogether on the non-limed plot, while yielding small crops on the limed plots. It is evident from the annually diminishing outturn of the cold weather crops that the effect of the lime is wearing off, and the experiment will be continued without further manurial treatment of the plots to ascertain how long the effect of the lime will last.

This year the *aus* paddy results are omitted as unreliable, since, through oversight, some of the plots were weeded and others not. The results of the cold weather crops are given below in lb. per plot.

Crop.	Lime and Bonemeal.		Lime.		Nil.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Matikalai ...	6	12	3¾	9½	1	2½
Mustard	1¾	...	½	...	Nil	Nil
Oats	14	...	11	...	Nil	Nil

The only thing that grew at all on the non-limed area was a very miserable crop of *matikalai*. This experiment has all along been regarded as qualitative rather than as quantitative, and figures are given only to emphasize the fact that, in the absence of liming, some crops, *e.g.*, oats and mustard produce absolutely no crop at all.

Block C.

Liming and manurial experiment.

13. This experiment commenced in 1911 was continued in its third year. The plots which had ten maunds lime per acre in 1911 and 1912 were given a third dressing of ten maunds during the year under report, and the bonemeal and cowdung dressings were applied as before. The plots which received initial lime dressings of 30 maunds and 60 maunds per acre, respectively, in 1911 received no addition of lime.

The cropping during 1913-14 was :—

	Non-green manure block.	Green manure block.
Rains ...	*Aus* paddy ...	Cowpeas for green manure.
Cold weather...	Barley ...	Barley.

Notes made during the growing period of the crops go to show that *aus* paddy is most unsatisfactory as a test crop for manurial experiments on this farm. This was specially noticeable on the portions crossdressed with bonemeal, where the phosphate had encouraged an enormous growth of grass weeds which had a most prejudicial effect on the crop. The difficulty of keeping this crop clean in the showery weather prevalent during its growth is so serious that we have decided to abandon the crop altogether, and have cut it out of the rotation from this year. Two years ago when *aus* came into the rotation we experienced the same difficulty, the results being practically worthless on this account. Cowpeas for green manure did very well, but made better growth on the lime plots, the heaviest growth of all being on the portions of the limed plots crossdressed with bonemeal.

The cold weather crop, barley, appeared to be much better on the green manured block than on the non-green manured block. In both blocks the crop on the plots annually dressed with ten maunds lime (10+10+10) looked much better than that on the 30 maunds lime plots.

The results in lb. of paddy and barley grain per acre are set out in Table VII.

TABLE VIII.

BLOCK C.

Aus paddy and barley.

Third year of experiment.

Cross dressings.	Non-green manured block.				Green manured block.			
	No lime.	Lime 30 mds. (10 + 10 + 10).	Lime 30 mds.	Lime 60 mds.	No lime.	Lime 30 mds. (10 + 10 + 10.)	Lime 30 mds.	Lime 60 mds.
Nil	P—320 lbs. B—Nil	P—240 lbs. B—560	P—220 lbs. B—500	P—180 lbs. B—670	... B—Nil	... B—690 lbs.	... B—470 lbs.	... B—710 lbs.
Bonemeal 3 maunds per acre in first, second and third years.	P—100 B—Nil	P—190 B—590	P—140 B—500	P—220 B—550	... B—10 lb.	... B—710	... B—310*	... B—780
Bonemeal 3 maunds and cowdung 100 maunds per acre in first, second and third years.	P—170 B—Nil	P—210 B—620	P—210 B—540	P—200 B—520	... B—30	... B—780	... B—620	... B—1,270
Cowdung 100 maunds per acre in first, second and third years.	P—370 B—Nil	P—220 B—780	P—220 B—640	P—440 B—720	... B—20	... B—640	... B—700	... B—980

All figures are per acre.
One maund = 82 lbs.
P = Paddy grain.
B = Barley grain.

* This figure appears to be erroneous.

In considering the above table the *aus* paddy crop may be neglected for reasons already given. The barley figures, however, are instructive and generally bear out the conclusions arrived at from the results of the two previous years. In the non-green manured block the average outturn per acre for all plots is 449 lb as against 545 lb for the green manured block, the advantage on the green manured side being not so great as anticipated from the appearance of the crop during its growth. The effect of the green manure is greatest on the plots receiving the heaviest dressing of lime, *e.g.*, taking the 60 maunds lime plots there is an average advantage of 320 lbs. per acre in favour of the green manured plots, indicating that, when green manuring is practised, heavier dressings of lime are required to get the full advantage of the green manure. Another point brought out this year is the superiority of the plots which receive ten maunds of lime annually over the 30 maunds plots which got the lime all in one dressing in 1911. This is especially noticeable in the green manured block.

As is usual with the cold weather crop, the plots receiving *no lime* produced *no crop*, with one or two exceptions in the green manured block where it is very probable that a certain amount of lime has been washed over from the neighbouring 60 maunds lime plot.

The largest crop is obtained on the plot which received the heaviest dressing of lime *plus* bonemeal *plus* cowdung *plus* green manure.

Block C.

Wood ashes experiment.

14. This experiment was commenced in 1911 with the object of ascertaining how far applications of wood ashes would replace lime in the improvement of this soil. There are five plots receiving per annum respectively 5, 10, nil, 15, and 20 maunds of wood ashes per acre. Half of each plot is cross dressed with cowdung at the rate of 100 maunds per annum. *Aus* paddy followed by oats in the cold weather was the cropping for the first three years. Each successive year the effect of the ashes is becoming more marked, and this year the 20 maunds plot *plus* cowdung yielded 826 lbs. of oats (grain) per acre, the 15 maunds plot *plus* cowdung 476 lbs. and the 10 maunds plot *plus* cowdung 238 lbs. The "no manure" plot never produces any oat crop, as also the 5 maunds plot without cowdung, while the 5 maunds plot *plus* cowdung yielded a very small crop this year.

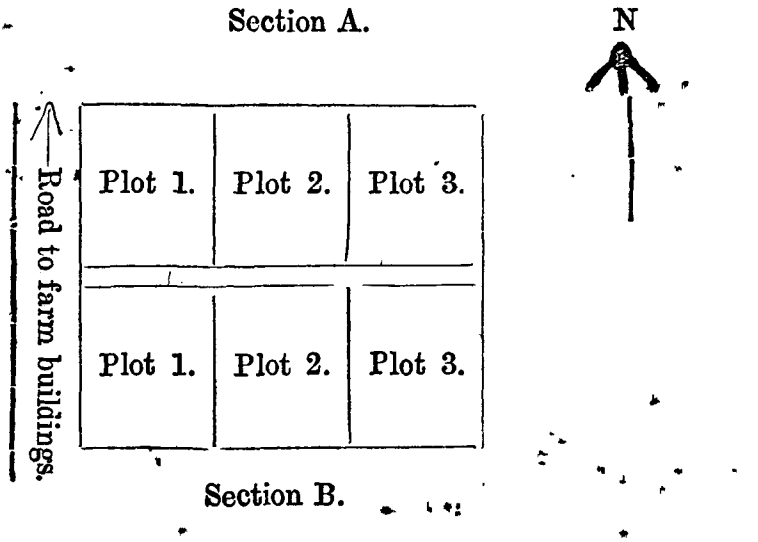
The effect of the wood ashes appears to be qualitatively the same as lime, but very much larger quantities will have to be

used to get as good results. Still the cumulative effect of the larger dressings is beginning to tell, as witnessed by the crop of oats harvested this year.

This is important from the point of view of the cultivator who is not in a position to lay out money in lime, as in most parts of the province there is an abundance of jungle which can be converted into ashes for nothing except the labour employed in collecting it.

Limestone Experiment.

15. *Block L.*—This experiment was laid down in the spring of 1913 on new land in the area recently added to the farm. There are 6 plots each ⅓ acre arranged thus :—



There are 3′ turf divisions between plots, and 8′ turf divisions between the sections. Section A will be cultivated shallow with country implements, while section B will be deep cultivated with English ploughs.

The land was under grass closely grazed. After it was broken up and a fair tilth obtained, ground limestone was applied as follows :—

Sections A and B Plot 1—15 mds. limestone per acre.

Plot 2— Nil.

Plot 3—30 mds. limestone per acre.

The cropping over the whole area was cowpeas for green manure in the rains followed by oats in the cold weather.

The cowpeas germinated and grew well on all the plots, but the growth was heavier on the limed plots, the heaviest growth being on the 30 maunds limestone plots.

The oats germinated well on all plots, but soon after germination died out entirely on the untreated plots.

All the treated plots matured a crop which was harvested, threshed and weighed, the results being given in Table IX:—

TABLE IX.

Oats.

(*Figures are per acre.*)

Plot.	Treatment.	Section A.		Section B.	
		Grain.	Straw.	Grain.	Straw.
1	2	3	4	5	6
		lbs.	lbs.	lbs.	lbs.
1	15 maunds limestone ...	369	796	214	715
2	*Nil.*	*Nil.*	*Nil.*	*Nil.*	*Nil.*
3	30 maunds limestone ...	537	1,422	615	1,104

The above figures indicate that finely ground limestone has a very striking effect on this soil immediately after application. The effect on the cowpeas was apparent within three months of application, and the effect on the oat crop in the same year is overwhelming. The untreated plots produced *no crop at all* as against poor to fair crops for the treated plots.

It is evident that the smaller dressing of limestone is insufficient on this soil, while probably the larger dressing of 30 maunds per acre is also rather on the conservative side.

It must be remembered, however, that, with the exception of green manure, no other manures were applied to any of the plots, and that this soil is inherently deficient in plant food with the possible exception of potash.

16. *Block E.*—This block was limed at the rate of 30 maunds slaked lime per acre in 1909, and was green manured with cowpeas the same year. In 1910 and 1911 it carried crops of sugarcane manured with 500 maunds of cowdung and 20 maunds

Flour phosphate experiment.

rape cake per acre respectively. This was followed by *aus* paddy and *matikalai* in 1912 without manure. In 1913 a plot measuring ·7 acre was dressed with 7 maunds per acre Flour phosphate, and the whole area was green manured with cowpeas in preparation for sugarcane again in 1914. Following the cowpeas, mustard was taken during the cold weather of 1913-1914.

It is proposed to record the effect of the phosphate on each crop during the succeeding rotation.

The effect of the phosphate was very great on the mustard as will be seen from the following figures :—

Yield per acre on phosphate area	...	231lb grain.
Ditto non-phosphate area	...	22lb ,,

Practically the crop failed altogether on the non-phosphate area, while on the phosphate plot, although the crop was poor, yet there was a *crop*.

This only confirms our previous experience in Block C experiment that in the case of mustard, phosphatic manuring is absolutely essential on this soil, otherwise, whatever the manurring the crop fails altogether.

Summary of results of this year's soil investigation work.

17. On the whole, this year's results, confirm the results obtained in previous years, the chief among which is that in order to grow most ordinary crops on this soil a preliminary dressing of lime is absolutely essential. The exact amount of lime to be applied and the frequency of application is not so clear. The results of Block C experiment rather tend to show that, after the first two years, 10 maunds per acre of slaked lime applied annually for three years will give better results than 30 maunds applied once in three years, but in the case of the smaller annual dressing it would probably be advisable to increase the initial dressing to at least 20 maunds per acre. However, it is hoped that more light will be thrown on this point before the experiment is finished.

The most striking result this year is undoubtedly the rapid effect of the applications of ground limestone on Block L. How long this effect will last, and also whether it will be more pronounced in the second year remains to be seen, but the fact remains that it does have a marvellous effect on the soil almost immediately after its application ; and this is important in view of the fact that the cost of ground limestone at present is little more than half that of slaked lime delivered at the farm.

18. *Aus* paddy was grown on Block B followed by *matikalai*. The outturn of the paddy was poor. The *matikalai* was a little better, yielding 16¾ maunds on about 3 acres. Block F received a dressing of wood ashes from the sugar boiling furnaces and was subsequently sown with cowpeas for seed, but these had to be burnt before coming to maturity owing to a severe attack of insects.

Other crops.

Block H was under ratoon cane, most of which was sent to Kamrup.

Small plots of soybeans, groundnuts, and Buri and Cambodia cotton were put down in the kitchen garden. Half the area to be sown with soybeans and groundnuts was given a dressing of 7 maunds of flour phosphate per acre. The soybeans were resown three times but practically failed on account of wet weather. Groundnuts did fairly well, the yield from the area dressed with flour phosphate being 1,316 lb. per acreas against 1,062lb. per acre from non-phosphate area.

Both varieties of cotton did very badly. The crop was sown rather late and apparently the heavy rains were unfavourable to the healthy growth of the plants.

19. There are now about a dozen Muzafferpur lichi trees on the farm. For some reason or other those near the bank of the tank are gradually dying out. Those further away from the tank, however, are making good growth and bore fruit this year.

Fruit.

Of three varieties of pineapples, *viz.*, Ceylon, West India and Spanish, the Ceylon does best, and there are a large number of plants of this variety now on the farm. A quantity of good quality fruit is produced, but it is difficult to protect it from the attentions of birds which swarm in the neighbouring sugarcane fields.

Three Langra mango trees ripened fruit for the first time this year, but the prospects of this fruit are not particularly hopeful at Jorhat.

Guava trees are making good vegetative growth and are fruiting annually, but the fruits are gradually degenerating.

20. The receipts amounted to Rs. 1,462 *plus* Rs. 600 (value of cane despatched to Kamrup) equal to Rs. 2,062 total. The total expenditure, including Rs. 2,220 for establishment and Rs. 2,958 for capital charges, was Rs. 10,839.

Receipts and Expenditure.

Work cattle.

21. Two pairs of bullocks were purchased at Sonepur fair at a total cost of Rs. 325 including freight and attendance charges for delivery at the farm. One bullock died of old age during the year.

Establishment.

22. This consists of a Farm Superintendent on Rs. 100-10-200, a Fieldman clerk on Rs. 25--1-8—40 and a peon on Rs. 8. During the year Government sanction was obtained for two more apprentices bringing the total up to four.

These posts are now held by :—

Bhola Nath Gogoi appointed October 25th, 1912.
Bhudhar Phukan „ November 10th, 1912.
Anandi Ram Gohain „ April 5th, 1914.
Davendra Nath Hazarika appointed April 5th, 1914.

Srijut Bina Ram Das held the post of Farm Superintendent and I am pleased to be able to report great improvement in his work during the year. Srijut Devi Prasad Gohain was Fieldman-clerk up to June 15th when he left to join the Bihar Agricultural College, having been nominated as a Government scholar. This vacancy had not been filled at the end of the year.

Inspection.

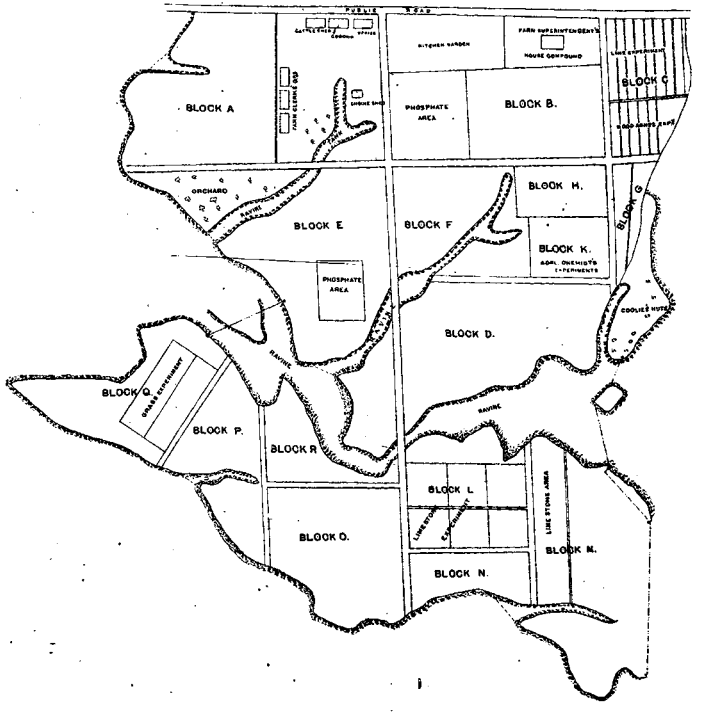
23. The Director of Land Records and Agriculture inspected the farm three times. The Deputy Director visited Jorhat 10 times inspecting the farm several times on each occasion. Mr. A. A. Meggitt joined his new appointment as Agricultural Chemist, Assam, on January 10th, 1914, and remained at Jorhat, in connection with the sugarcane and soil investigation work until April 4th, when he went on leave.

A. G. BIRT,

The 30th July 1914. *Deputy Director of Agriculture, Assam.*

MAP
OF
JORHAT FARM

Scale 32 : 1 Mile



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5-6-1914

D.O. Shillong. R.S. No. 1263 of 1914

ANNUAL REPORT OF THE UPPER SHILLONG AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING JUNE 30TH, 1914.

History and description.

The Upper Shillong Agricultural Station was established in 1897-98. It is situated on the Cherrapunjee road, 5½ miles from the town of Shillong, and occupies the site of the old "Model Farm" which ceased to exist in 1879. The elevation of the station is 5,900 feet, *i.e.*, about 900 feet higher than Shillong town. A large area of pine forest was annexed to the station in 1905. The total area of the farm, inclusive of forest, is 336·67 acres. Most of the cultivated land lies in a long narrow valley, the bottom of which consists for the most part of marshy land covered with thick growth of wild grass. A considerable area of this marshy land has been reclaimed by deepening and straightening the stream which drains the valley and cutting lateral *nullahs* to connect with it. A part of this area has been bush-drained. The work of reclamation is being continued and extended. The results of the work already done are very apparent. Soft boggy ground on which previously it was unsafe to work has been converted into farm pasture land, and at the same time the herbage shows a marked change for the better.

The soil of the greater part of the station is a coarse reddish loam of very loose texture which can be worked with the greatest ease. The sub-soil is of a more pronounced reddish colour and of great depth. In a small portion of the station the soil is black owing, it is believed, to the existence of some mineral compound. At the bottom of the valley a different type of soil is found, namely, clay or clayey loam, extremely rich in organic matter. Having been under a thick growth of grass for many years, the upper portion of this soil is a matted mass of half decayed grass roots.

In point of quality, the soil of the farm is extremely poor, and very little can be grown on it without the help of manure. A sample of soil was analysed during the year by the Agricultural Chemist, but the analysis being of doubtful accuracy is not quoted here.

Besides the natural poverty of the soil, the greater portion of the station suffers from the disadvantages of an exposed situation It is colder and more windy than Shillong; frosts are of very

common occurrence and are more severe than in the town. During the winter the growth of vegetation is entirely suspended.

Purposes of the station.

2. The main objects for which the station was established were the introduction of superior varieties of potatoes which are the most important crop grown on the plateau of the Khasi Hills, the breeding of improved strains of cattle suitable for this tract, and the cultivation of fodder crops and making of ensilage for use in winter when green fodder is short. These objects are still kept in view, and in addition sheep-breeding experiments with the object of improving the local breed were commenced in 1909.

Weather.

3. The following table gives the rainfall during the year under report :—

	Inches.
1913—	
July	12·91
August	13·38
September	6·95
October	8·21
November	0·16
December	0·90
1914—	
January	0·00
February...	2·15
March	1·00
April	9·55
May	13·32
June	24·14
Total ...	92·97

The spring rains of 1914 were particularly favourable for the germination of the potato crop which has yielded a full outturn. The maize crop of 1913 suffered badly from heavy rain in May and June. Most of the autumn crops were untimely killed by early frosts.

Summary of work.

4. The work done during the year included :—

(1) Reclamation.

(2) Potato experiments.

(3) Potato growing for seed.

(4) Rotation experiments.
(5) Manure experiment in peaty soil.
(6) Rice experiments.
(7) Trials of new fodder crops.
(8) Trials of other new crops.
(9) Fodder crops for silage and hay.
(10) Cattle breeding.
(11) Sheep breeding.
(12) Distribution of seeds, implements, etc.

Reclamation.

5. The work of reclaiming the peaty land in the bottom of the valley was continued. Some 11 acres of land had been reclaimed in the previous year. A further area of about 8 acres was ploughed up and a part of it was bush-drained during the year with the intention of laying it down to grass for grazing. This particular area belongs to the Forest Department, though the farm is allowed to graze its cattle thereon.

The bush-drains are made by partially filling up the drains with brush-wood and finally covering them in with earth. This kind of drain is expensive to make, but cannot be expected to last long. Shortly after the close of the year, two experimental drains were made, in one of which the lower six inches were filled up with pebbles and covered with slates, and in the other slates only were used, these being placed in such a way as to leave a clear opening six inches deep all through. The two experimental drains which were 40 and 44 feet long, respectively, cost Rs. 19-8 and Rs. 16-3 per 100 running feet, respectively. The latter kind seems preferable in a clay sub-soil, as is the case with the land in the bottom of the valley. It is proposed, if funds permit, to drain a few acres of land in the current year by means of slate drains ; by arranging for a wholesale supply of slates, the cost may be reduced to about Rs. 10 per 100 running feet.

Potato experiments.

6. These included—

(*a*) Variety tests and
(*b*) A combined experiment to test whole *versus* cut sets and to compare different seed rates.

Experiments had been made for many years past to compare the merits of winter against those of summer seed, with the invariable result of the former shewing an enormous superiority over the latter. These experiments having attained their object were discontinued from last year.

7. The following varieties were compared in the season just closed (1914), each variety being planted on duplicate plots, each $\frac{1}{40}$th acre in area :—

Variety tests.

Khasi round, obtained locally in		...	...	1900
Khasi Nainital	ditto	...	...	1908
King Edward VII, from England		...	...	1906
Sutton's Magnum Bonum,	ditto	...	...	1908
Windsor Castle,	ditto	...	...	1909
British Queen,	ditto	...	...	1909
Up-to-date,	ditto	...	...	1909
King of Potatoes,	ditto	...	...	1912
Magnum Bonum,	ditto	...	...	1912
Windsor Castle,	ditto	...	...	1912
British Queen,	ditto	...	...	1912
Gladiator,	ditto	...	...	1912
Flour Ball,	ditto	...	...	1912
Harbinger,	ditto	...	...	1912
Imperator,	ditto	...	...	1912
Belle de Juliet,	ditto	...	...	1912
White City,	ditto	...	...	1912
Californian, from California		...	...	1912

All the varieties were planted in March and harvested in August. Sets were taken from the previous winter crop. The land was given a dressing of 300 maunds of cowdung and 10 maunds of rape cake per acre, and the crop was sprayed with 240 gallons of Bordeaux mixture per acre in two equal doses.

The outturns of each variety in 1914 and in previous years are exhibited in the following table :—

Statement showing the average yield per acre on duplicate plots for the last seven years.

Variety.	1914.		1913.		1912.		1911.		1910.		1909.		1908.		Average of last three years.		Average of seven years.	
1	2		3		4		5		6		7		8		9		10	
	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.
1. King of Potatoes ...	217	35	186	20	234	0	201	0	131	20	95	30	319	0	212	32	197	38
2. Magnum Bonum (1908) ...	214	0	165	20	232	0	160	35	132	20	87	30	277	0	203	33	181	15
3. King Edward VII ...	168	5	133	20	128	20	163	13	78	20	90	15	269	0	146	15	147	13
4. Khasi Naisital	189	0	174	10	166	20	157	30	119	0	111	30	292	0	176	23	172	35
5. Khasi Round	123	8	123	0	111	20	135	2	95	25	102	25	255	0	119	9	135	6
6. Windsor Castle (1909) ...	209	35	158	20	205	0	181	15	63	15	.....		.....		191	5	.....	
7. British Queen (1909) ...	196	5	152	30	181	20	189	35	92	30	.....		.....		176	32	.....	
8. Up-to-date	207	25	186	20	178	0	153	0	90	0	.....		.....		190	28	.....	
9. Magnum Bonum (1912) ...	170	10	156	0	224	0	.....		.....		.....		.....		183	23	.....	
10. Windsor Castle (1912) ...	238	20	129	0	196	0	.....		.....		.....		.....		187	33	.....	
11. British Queen (1912) ...	181	20	142	10	72	20	.....		.....		.....		.....		132	3	.....	
12. Gladiator	109	0	127	10	93	20	.....		.....		.....		.....		109	37	.....	
13. Flour Ball	142	10	160	30	173	0	.....		.....		.....		.....		158	27	.....	
14. Harbinger	146	30	108	30	126	0	.....		.....		.....		.....		127	7	.....	
15. Imperator	183	15	167	20	211	0	.....		.....		.....		.....		187	12	.....	
16. Belle de Juliet	96	0	63	20	81	20	.....		.....		.....		.....		80	13	.....	
17. White City	174	20	82	0	80	20	.....		.....		.....		.....		112	13	.....	
18. Californian	144	10	92	25	.....		.....		.....		.....		.....		.....		.....	

Of the older varieties, King of Potatoes again gave the highest yield, and the next best was Magnum Bonum (1908). The varieties named above stand in the same relative order on the average of the last seven years.

Of the varieties imported since 1909, Windsor Castle (1912) came out at the top, and excelled even the best of the older varieties. The next in order were Windsor Castle (1909), Up-to-date, British Queen and Imperator.

As in former years, 50 tubers of each variety were selected at random, cut open and examined for signs of disease. The following table gives the results of the last six years :—

Variety.	Number of diseased tubers.					
	1909.	1910.	1911.	1912.	1913.	1914.
1	2	3	4	5	6	7
King of Potatoes*	10	12	Nil.	Nil.	Nil.	1
Magnum Bonum (1908) ...	...	6	4	2	4	2
King Edward VII (1903) ...	Nil.	18	8	4	6	5
Khasi Nainital (1908) ...	10	48	16	8	4	4
Khasi Round (1900)	Nil.	4	8	6	10	6
Windsor Castle (1909) ...	...	...	...	4	3	3
British Queen (1909) ...	Nil.	12	Nil.	6	4	2
Up-to-Date (1909)	...	4	32	16	4	1
Magnum Bonum (1912) ...	...	...	...	6	6	2
Windsor Castle (1912) ...	...	...	...	4	3	2
British Queen (1912) ...	...	...	...	4	4	3
Gladiator (1912)	...	...	...	8	4	2
Flour Ball (1912)	...	...	...	6	3	1
Harbinger (1912)	...	...	...	2	8	2
Imperator (1912)	...	...	...	22	3	3
Belle de Juliet (1912) ...	...	...	...	6	Nil.	2
White City (1912)	...	...	...	10	9	15
Californian (1912)	...	...	...	...	3	17

* Figures for 1909-11 are for the old stock of King of Potatoes imported in 1906, while those for 1912-14 are for the new stock imported in 1912.

These figures must not be regarded as an absolute test of the amount of disease in the crop, but taken over a series of years they indicate to some extent the comparative disease-resisting power of the several varieties. It is clear, however, from the table that the amount of disease has steadily decreased since 1910 when it was at its worst, and this year, most of the varieties exhibited a very small proportion of diseased tubers. The three worst varieties in respect of disease were Californian, White City and Khasi Round.

Of the many varieties of potatoes tried on the farm, Flour Ball is the only kind which flowers, sets and matures fruit. Some ripe fruits were gathered from the crop of this variety in 1912, and the seed obtained therefrom was sown in the spring of 1913. Some of the tubers of the resulting crop were found to be white, and others of a pink colour These were separated and planted last season in two separate plots. The plants which came up from these tubers differed a good deal from each other in several important particulars such as colour of leaves and veins as well as of the tubers' habit of growth and flowering. Altogether seven different types were observed and a few plants of each type were marked out and separately harvested. The tubers from these have been preserved for sowing next year in order to compare the merits of the different types. One or two of these types seem promising.

Whole *versus* cut se's and different seed-rates.

8. Experiments had been made for several years past to compare the merits of whole *versus* cut sets under the conditions of climate and cultivation obtaining in the Khasi Hills. In the case of winter grown seed, the results of the experiments in 1911 and 1912 were contradictory, the 1911 experiments indicating that cut sets were more productive, while in 1912 the results were decidedly in favour of whole sets. In 1913 it was found that in case of summer seed, whole sets were preferable to cut sets, while for winter seed whole and cut sets showed little difference in point of outturn.

The results hitherto obtained having proved discrepant, the experiment was repeated this year (1914). It incidentally appeared in 1913 that in the case of cut sets of winter seed, the yield was not appreciably diminished by halving the seed rate (that is, by reducing it from 12 maunds to 6 maunds per acre). It was therefore decided to institute an experiment in 1914 with a view to determine the optimum seed rate for cut as well as for whole sets. This experiment was combined with the one intended to compare the respective merits of whole and cut sets. Winter

seed alone was used in the experiment, it being thought unnecessary to duplicate the experiment with summer seed which past experience had shown to be greatly inferior to winter seed in productive power.

For this combined experiment, 48 plots, each $\frac{1}{40}$th of an acre, were taken and divided into two series of 24 plots each, the two series being exact counterparts of each other. Out of the 24 plots of each series, 12 were planted with King of Potatoes and 12 with Magnum Bonum. Of the 12 plots planted with each variety in each series, 6 were planted with whole sets, and 6 with cut sets, and the 6 plots planted with each description of sets of each variety and in each series, received 6, 8, 10, 12, 14 and 16 maunds of seed per acre, respectively, the distance apart between the rows being 2 feet and in the rows 9 to 10 inches in case of each seed rate.

The crop was planted in the first week of March and manured with 300 maunds of cowdung and 10 maunds of oil cake per acre. It was sprayed twice with 120 gallons of Bordeaux mixture used each time.

The scheme of the experiment and the results obtained, are set forth in detail in the following table :—

Whole versus *cut sets and seed-rates.*

(Each plot $=\frac{1}{40}$*th acre.)*

Seed : whole or cut.	Seed rate per acre.	First series.		Second series.		Average yield per acre.	
		Plot No.	Yield per acre.	Plot No.	Yield per acre.		
1	2	3	4	5	6	7	
KING OF POTATOES.	Mds.		Mds. srs.		Mds. srs.	Mds.	srs.
Whole	6	1	160 20	19	150 20	155	20
"	8	2	195 0	20	189 30	192	15
"	10	3	214 0	21	245 0	229	20
"	12	4	230 20	22	248 30	239	25
"	14	5	228 0	23	258 30	243	15
"	16	6	* 224 0	24	* 258 20	* 241	10
Average of all seed-rates—Whole sets.	...	...	....	...	...	216	27½

* The asterisks indicate the few cases in which an increase in the seed rate was not attended by an increase in the yield—a discrepant result due in all likelihood to experimental error.

Whole versus *cut sets and seed-rates*—concld.

(Each plot = $\frac{1}{40}$th acre.)

Seed: whole or cut.	Seed rate per acre.	First series.		Second series.		Average yield per acre.	
		Plot No.	Yield per acre.	Plot No.	Yield per acre.		
1	2	3	4	5	6	7	
	Mds.		Mds. srs.		Mds. srs.	Mds.	srs.
Cut	6	7	218 20	13	177 0	197	30
,, ...	8	8	* 184 30	14	196 30	* 190	30
,, ...	10	9	211 10	15	224 10	217	30
,, ...	12	10	235 0	16	229 10	23	5
,, ...	14	11	258 20	17	232 20	245	20
,, ...	16	12	283 0	18	* 230 30	256	35
Average of all seed rates—Cut sets.	...	...	...	...	...	223	18
MAGNUM BONUM.							
Whole	6	30	183 0	48	182 20	182	35
,, ...	8	29	197 0	47	183 20	190	10
,, ...	10	28	205 10	46	203 0	204	5
,, ...	12	27	234 0	45	229 20	231	30
,, ...	14	26	* 219 30	44	245 20	232	25
,, ...	16	25	250 0	43	245 20	247	30
Average of all seed-rates—Whole sets.	...	...	...	...	...	214	35
Cut	6	36	188 20	42	166 0	177	10
,, ...	8	35	234 30	41	199 20	217	5
,, ...	10	34	* 210 30	40	212 20	* 211	25
,, ...	12	33	236 0	39	235 20	235	30
,, ...	14	32	241 10	38	240 20	240	35
,, ...	16	31	264 0	37	252 20	258	10
Average of all seed rates—Cut sets.	...	...	...	...	...	223	19

* The asterisks indicate the few cases in which an increase in the seed rate was not attended by an increase in the yield—a discrepant result due in all likelihood to experimental error.

First, with regard to the outturns obtained from the use of whole sets and cut sets respectively. These, quoting from the foregoing table, were as follows :—

Whole or cut sets.	Seed rate per acre.	King of Potatoes (average of duplicate plots).	Magnum Bonum (average of duplicate plots).
1	2	3	4
	Mds.	Mds.	Mds.
Whole	6	155	183
Cut		198*	177
Whole	8	192	190
Cut		191	217*
Whole	10	229	204
Cut		218	212*
Whole	12	240	232
Cut		232	236*
Whole	14	243	233
Cut		245*	241*
Whole	16	241	248
Cut		257*	258*
Average of all seed rates taken together.			
Whole	...	217	215
Cut	...	223	223

If we compare the outturns for each seed rate separately, the results appear to be discrepant, cut sets yielding a larger outturn than whole sets in 8 cases (marked with asterisks), and the reverse being the case in the remaining four. Such discrepancies are unavoidable in a field experiment in which the conditions of

soil, manure and cultivation are never actually, though apparently, uniform. The differences in yield which were in all but 2 of the 12 contrasted pairs less than ten per cent. might be set down to accidental error.

But if we take all the seed-rates together, the chances of accidental error are greatly reduced and the averages thus obtained may be accepted as reliable. The averages show cut sets to be but very slightly superior to whole sets, the difference in outturn in favour of cut sets amounting only to 6 mds. or 3 per cent. in case of King of Potatoes and 8 maunds or 4 per cent. in case of Magnum Bonum. These differences are so slight that one might safely say that there was not much to choose between the two descriptions of seed, and that both are equally good.

The results of the experiment viewed in this light may be taken as decisive, and there will be no object in repeating it next year. It is to be remembered, however, that while whole and cut sets are under ordinary conditions equally good, there are circumstances in which the use of the one or the other is preferable. For instance, with small seed tubers, it would be inadvisable to cut them up into smaller sets, while with large sized seed, it would be very desirable to split them up in order to reduce the cost of the seed. Then again, if the potatoes happen to be infected with disease, it is very desirable to cut open each tuber and reject such as show any sign of infection.

Secondly, with regard to the merits of the different seed-rates, the yields were as follow, taking whole and cut sets together :—

Seed-rate per acre.	Variety.	Yield per acre.	Average of two varieties.	Increase in yield for each extra 2 mds. of seed.
1	2	3	4	5
Mds.		Mds	Mds.	Mds.
6	King of Potatoes ...	177	178	...
	Magnum Bonum ...	180		
8	King of Potatoes ...	192	198	20
	Magnum Bonum ...	204		
10	King of Potatoes ...	224	216	18
	Magnum Bonum ...	208		

Seed-rate per acre.	Variety.	Yield per acre.	Average of two varieties.	Increase in yield for each extra 2 mds. of seed.
1	2	3	4	5
Mds.		Mds.	Mds.	Mds.
12	King of Potatoes ...	236	235	19
	Magnum Bonum ...	234		
14	King of Potatoes ...	244	241	6
	Magnum Bonum ...	237		
16	King of Potatoes ...	249	251	10
	Magnum Bonum ...	253		

The figures of yield in the third column are averages of four plots, and those in the next column are averages of eight plots. Errors due to accidental differences in soil and cultivation, which are indicated by asterisks in the table on pages 8 and 9 have been reduced by averaging.

It will be seen that each increase of two maunds in the seed rate was attended by a greater or less increase in the yield. The rate of increase was greatest with the smaller seed rates, there being an increase of 18 to 20 maunds at each step. It fell off to 6 maunds between 12 and 14 maunds of seed rate, though it was somewhat greater, apparently owing to accidental error, when the seed rate was raised from 14 maunds to 16 maunds.

From a consideration of these figures it would seem that under the conditions of soil and cultivation we have to deal with in the Khasi Hills, the optimum seed rate would be somewhere in the neighbourhood of 12 maunds per acre. This is the seed rate ordinarily used on the farm.

Potatoes for seed.

9. Of the many varieties of potatoes tried, the three which had proved most prolific, *viz.*, King of Potatoes, Magnum Bonum and Up-to-date, were grown this year (1914) for seed. The total area planted was $9\frac{3}{4}$ acres. The time of planting extended from 16th February to 20th March. The manures used were 150 maunds of cow-dung and 10 maunds of rape cake per acre, except that on a portion of the area, where the soil seemed particularly poor an extra dose of 50 maunds of cow-dung was applied. The crop was sprayed with Bordeaux mixture twice at the rate of 120 gallons

of mixture each time. The total quantity of sets used was 142 maunds 36 seers. which gave an average seed rate of 12 maunds 30 seers per acre. The outturn was as follows :—

Variety.	Area in acres.	Yield. Mds.	srs.
King of Potatoes	4·875	770	24
Magnum Bonum	4·100	679	22
Up-to-date	0·775	64	33
Total ...	9·75	1,514	39

The average yield for the whole area amounted to very nearly 155 maunds or 5·7 tons per acre. In 1913, the total area planted with potatoes for seed was 9·65 acres and the total yield was 1,038 maunds giving an average of 105 maunds to the acre. The better outturn of 1914 was due wholly to more favourable weather.

To these maunds 1,515 have to be added the following quantities which were obtained from the experimental area :—

	Mds.
King of Potatoes	142
Magnum Bonum	142
Up-to-date	10

These bring up the total quantity of potatoes available for seed purposes to 1,808 maunds. The greater portion of this quantity, that is after excluding small and defective tubers and setting apart the quantity required for the farm, will be available for sale as seed to the public.

From the crop of 1913, 804 maunds of King of Potatoes and Magnum Bonum were sold during the year to the public (see paragraph 18). The price charged was Rs. 3-4 per maund which was the average bazar rate last season. For the convenience of Khasia cultivators wanting to purchase our seed, temporary depôts were opened last year at Cherrapoonjee, Mawphlang, Lad Mawphlang, Dumpep, Laitlyngkot and Marbisu, and an extra charge of 8 annas to Re. 1 per maund was put on to cover the cost of transport to the depôts. Depôts at the same places and also one at Mawkhar have been opened this year again, but instead of charging a fixed price all through the season, it has been decided to sell the potatoes at the current bazar price which

varies from week to week. At the same time steps have been taken to reduce the cost of transport which was somewhat excessive last year.

The total of the experimental and non-experimental areas cropped with potatoes in 1914 was 11·84 acres. The total yield of potatoes from this area was 1,931 maunds which gave an average of about 163 mds. to the acre. The total cost of cultivation, exclusive of the cost of cow-dung and charges for rent and supervision, amounted to Rs. 1,926-9-3 or practically Re. 1 per maund. The sale price at the time of harvest fluctuated between Rs. 2 and Rs. 2-8 per maund.

Rotation experiment.

10. This experiment was initiated in the previous year (1912-13) to compare the effect of cow-dung alone and cow-dung *plus* insoluble phosphates on limed and unlimed areas, through the following rotation :—

1st year potatoes.
2nd „ maize.
3rd „ soybeans.

The plan of the experiment is as follows, each plot being $\frac{1}{40}$th acre in area :—

Lime.	No lime.
6 plots numbered 6, 5, 4, 3, 2, 1.	6 plots numbered 6, 5, 4, 3, 2, 1.
No lime.	**Lime.**
6 plots numbered 6, 5, 4, 3, 2, 1.	6 plots numbered 6, 5, 4, 3, 2, 1.

Slaked lime was applied at the rate of 10 maunds per acre about a month before the first crop of the rotation, *viz.*, potatoes, was planted in 1913, and the following manures were applied in the drills at the time of planting the potatoes :—

Plots 1 and 4 ... 300 maunds of cowdung per acre.
„ 2 and 5 ... 300 maunds of cow-dung *plus* 3 maunds of flour phosphate per acre.
„ 3 and 6 ... 300 maunds of cow-dung *plus* 3 maunds of raw bone meal per acre.

The flour phosphate and bone meal were mixed with the cow-dung before application.

The first crop of the rotation, potatoes, grown in the summer of 1913, did not show any appreciable benefit from the application of lime or the phosphates. The second crop of the rotation, maize, was sown in May last. It was not to receive any manure and so none was applied. The crop is now on the ground, but shows a very poor growth. The soil is of a very loose texture and appears to be incapable of retaining manure. The experiment is not expected to yield any positive result.

Manure experiment on peaty soil.

11. This is a new experiment. It is designed to test the effect of lime and bonemeal on peaty soil. Two large plots of land in the bottom of the Valley have been selected for the experiment. The land had been a marsh and reclaimed by draining. Each plot was divided into four equal areas and the four sub-plots were treated as follows :—

Sub-plot 1.—Manured with 30 maunds of lime per acre.

„ 2.—Manured with 30 maunds of lime and 3 maunds of bone meal per acre.

„ 3.—Manured with 3 maunds bone meal per acre.

„ 4.—No manure.

N.B.—One maund = 80 lbs. roughly.

One of the two plots which has an area of 1 $\frac{1}{20}$ acres was sown with soybean in May last and the other plot having an area of $\frac{7}{10}$ acre was sown at the same time with maize. The land in each case had received several ploughings during the winter and spring months, but is still in a more or less sour condition, even in those sub-plots which have received lime. The soybean and maize crops are now on the ground. The maize looks very poor and is evidently suffering from the acidity of the soil. The soy bean appears more promising. The actual result will not be known till next autumn.

Rice experiments.

12. It was reported in the last Annual Report of the Farm that two acres of newly reclaimed marsh land had been put under rice for the first time in 1913. Half the area was sown with rice broadcast in the ordinary local way, the seed rate being 100 lbs. per acre, and on the other half transplanting was tried with single plants about 6 inches apart, the seed-rate used being only 25 lbs. per acre. The object was to test the merits of transplanting against broadcast sowing. It was also intended to test the effects of bone meal and flour phosphate which were applied in some portions of the land, while the rest remained unmanured. The experiments, however,

proved abortive. The yields obtained were so poor as to count for next to nothing. The land, though reclaimed from marsh, still remained full of tough masses of grass roots and very little real soil was visible on the surface. It will take some years for the grass roots to decompose and for a sufficient depth of soil to collect at the top. The latter process may be artificially hastened by bringing down silt with water from the hill slopes and causing it to settle on the land—a method of improving rice-land which is well-known to the Khasias. It is proposed to adopt this method from next winter.

An additional area of two acres was added to the rice land during the year under report. These two acres, together with the two acres taken up in the previous year, have again been sown with rice, partly broadcast and partly transplanted. But the crop which is now on the ground looks no better than last year, and is not expected to give any results worthy of record.

Trials of new fodder crops.

13. Mention was made in the last Annual Report of several species of exotic and Indian fodder crops having been sown as an experiment in the spring of 1913. The exotic fodders tried were lupins, swedes, turnips, mangels, sugarbeet, lucerne, swordbeans, florida velvet beans and some species of Australian grasses and clover. The crops germinated well, but with the exception of lupins, swedes, and turnips, none were able to survive the monsoon rains. Lupin continued to grow and flower till the end of October when it was prematurely killed by early frosts. A few pounds of seed was saved and was sown again in May last. The crop grown from the new sowing is now on the ground and seems to be doing well. Swedes were sown on $\frac{1}{10}$ acre in May 1913 on land which had been liberally manured with cow-dung and phosphates. The crop made fair growth and stood the rains fairly well, but the outturn of roots was small —4¼ maunds (340 lbs.) from the tenth of an acre. A similar area was sown with turnips, but these suffered more from the monsoon rains than the Swedes and gave only 2¼ mds. (180 lbs.). of roots. The failure of the exotic fodder crops last year only served to confirm the experience of previous years that the peculiar climatic conditions of the Shillong plateau, with its heavy spring and monsoon rainfall followed by a dry cold winter, are not suited to those crops.

The Indian fodders which were tried during the year were Darjeeling soybeans, radish, and a native wild grass called *Tyrdip*.

The soybean was sown in May and grew well till October when it was prematurely killed by frost. Radish was sown on 2·65 acres of land in September after a crop of summer potatoes. It grew well until it was overtaken by the October frosts and killed out. A small yield of green fodder and roots was obtained and fed to sheep in the winter. *Tyrdip* is a local fodder grass. About half an acre of land was planted with it in March 1912. The land was lightly ploughed once in May 1913 and a hoeing was given to it in January 1914. The grass was found to spread laterally on the ground instead of forming thick upright clumps. It seems more suited to grazing than for cutting for green fodder or hay. The crop was mown in October last and gave only two loads of hay from about half an acre of ground.

Other crops.

14. *American maize.*—Seed of five varieties was saved from the previous year's crop and sown on small plots separately in different parts of the farm. All failed except one, *viz.*, Early Huron Dent which produced a small quantity of grain. The seed was saved and has been sown this year for a fresh trial.

Rhubarb.—About $\frac{1}{10}$th acre was planted in October 1912 with plants removed from the old Fruit Garden at Umlyngka. The land had been liberally manured with cow-dung before planting, and received a further dressing of manure last winter. The crop has grown exceedingly well. Between April and June last, it yielded 171lbs. of stalks which were sold locally for Rs. 17-14-0. Several Khasi cultivators in the neighbourhood of Shillong have taken to the cultivation of this vegetable and they bring it for sale in the local bazar.

Strawberries.—Nine varieties, removed from the Fruit Garden at Umlyngka, were planted on about $\frac{1}{20}$th acre. Only one variety, Louise Gautier, has done well. Last spring it yielded an outturn of 14lbs. of fruit from an area of 30 square yards which is equal to $\frac{1}{160}$th of an acre. It was sold locally at 12 annas per lb. This variety has done well throughout since its introduction in the Umlyngka Fruit Garden several years ago.

Asparagus.—One-third of an acre was planted with Asparagus in October 1912. The crop is doing very well. It was decided not to pick any shoots last spring, but to let the crop grow for another year and get strong so as to yield a good picking next year.

Buck wheat.—It was sown on $\frac{1}{10}$th acre in May 1913. The sowing proved untimely; the crop suffered greatly from the heavy monsoon rain and yielded a meagre outturn of only 4lbs. of grain. The crop will be tried again in the current year.

Fodder crops for Silage and Hay.

15. The fodder crops grown during the year and their yields are shown below :—

Name of fodder crop.	Area sown in acres.	Outturn of green fodder.	Outturn of hay.	Remarks.
1	2	3	4	5
		Mds.	Mds.	
Maize	14·7	557 = 20·5 tons ...	...	Ensiled.
Langtylli	2·5	43 = 1·5 tons ...	...	Ensiled. Scientific name not known.
Wild grasses	...	117 = 4·3 tons ...	...	Ditto ditto.
Raishan millet (Paspalum Sanguinale).	33·07	...	412 = 15·1 tons.	Made into hay.

The maize crop was greatly damaged by heavy rain during early growth and gave a poor yield of fodder. The total quantity of fodder ensiled amounted to 717 mds.(=26·3 tons). Only one pit silo was used. Five hundred and one maunds or about 70 per cent. of the fodder put in was recovered as silage. The total cost of the silage was Rs. 442-7-1 which was made up as follows :—

	Rs.	a.	p.
Cost of cultivation and harvesting of maize 14·7 acres ...	323	3	1
Ditto ditto of Langtylli 2·5 acres	62	9	6
Cost of collecting wild grasses	14	0	0
Cost of chopping fodder and filling silo	42	10	6
Total	442	7	1

The cost per maund of silage amounted to about 14 annas per maund which was 50 to 100 per cent. more than what it ordinarily costs. The high cost was due principally to the very poor yield of the maize crop. The Langtylli grass too gave a miserable outturn of green fodder. It was at one time hoped that it might be profitable to cultivate this grass which is wild in the Khasi Hills, but I am now led to think that it will not pay to grow it as a cultivated crop.

Raishan was grown in a number of fields with an aggregate area of 33·07 acres. A small portion of this area was sown with soybean in mixture with Raishan, but the soybean plants remained stunted and did not amount perhaps to even one per cent. when the mixed crop was cut for hay. The sowings of Raishan and soybean extended from the beginning of April to

the middle of June 1913. The crop was cut for hay in October. The total yield of hay was 412 maunds (15·1 tons) which cost Rs. 582 or about Rs. 1-6-6 per maund.

Both the silage and hay proved exceedingly useful for feeding the farm stock during the winter.

This year about 7½ acres of maize and 30 acres of *Raishan*, soybean and jobs' tears have been sown for fodder. The maize crop promises a good outturn of fodder. The greater part of the land sown with the other fodder crops received little cultivation and no manure. The crops are allowed to come up along with wild grasses, the object being to cut them all together and use them for either silage or hay.

Cattle breeding.

16. The following table shows the number of cattle in the herd on 30th June 1914 :—

Description.	Patna (P).	Bhutia (B).	P × B.	P × B × P.	P × B × P × P.	P × Khasi.	P × K × P.	Total on 30th June 1914.	Total on 30th June 1913.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
Breeding bulls ...	2	...	...	...	...	...	...	2	2	
Bulls (3 years and above) ...	2	...	...	3*	...	2	4	11	9	* Are being used as plough cattle.
„ (2 to 3 years) ...	2	...	2	1	...	...	...	5	4	
„ (1 to 2 years) ...	2	...	1	1	...	...	...	4	6	
„ (under 1 year) ...	2	...	...	...	...	...	...	2	6	
Heifers (2 to 3 years) ...	3	...	...	...	...	...	...	3	4	
„ (1 to 2 years) ...	1	...	...	4	1	...	...	6	5	
„ (under 1 year) ...	2	...	1	6	...	...	...	9	4	
Cows	9	1	5	2	...	...	...	17	16	
Total on 30th June 1914 ...	25	1	9	17	1	2	4	59	...	
Total on 30th June 1913 ...	27	1	7	13	...	2	6	...	56	

In addition to the above, there were 3 Hindustani and 5 Khasi bullocks. The total number of cattle was, therefore, 67 as against the same number on the 30th June 1913.

During the year, twenty-one animals were born, 12 died and 9 were sold. Of the 12 deaths as many as ten were young stock under one year, and two were old Patna cows. The mortality among the calves was excessive, most of the deaths being attributed to a disease known as white scour. Since 1911 it has been the practice to bring up the calves by handfeeding, the object being to accustom the cows to be milked without the calves. It has been found easy enough to feed the calves from a pail, but the cows, as a rule, refuse to be milked in the absence of the calves. This too has been the experience in most places in India where attempts have been made to milk cows without bringing the calves before them. There is danger besides in handfeeding the calves, on account of the risk to their health from drinking milk contaminated by accident, a risk which it is not possible to avoid altogether in view of the uncleanly habits of the men who are entrusted with the management of the cattle. I am inclined to attribute to this cause the excessive mortality which occurred last year among the young stock. The handfeeding of calves has accordingly been stopped and replaced by the ordinary practice of allowing them to suck their mothers.

Of the 9 animals sold, five (*viz.*, 3 Patna and 2 Patna × Khasi) were breeding bulls, one was a Patna × Bhutia heifer and three were Khasi plough bullocks which were weeded out as useless for further work. Three more breeding bulls were sold during the year, but they were not taken delivery of by the purchaser before the close of the year. With these three bulls the total number sold during the year would be 8 against 12 in the preceding year.

The eight bulls sold were purchased one by Mr. Fergusson of Dhamai Tea Estate in Sylhet, one by the Rangpur Dairy Farm, one by the Local Board of Nowgong, one by a European resident of Shillong, one by a Khasi cultivator, and three by the Bengal Veterinary Department.

The pure-bred bulls were sold, as in previous years, at Rs. 50 each and the cross-bred bulls at Rs. 40 each. These prices are much too low, but we have to sell at these purposely low rates in order to suit the means of the small cultivator.

It has become a question for serious consideration whether we ought to continue to spend a large amount of money annually for the sake of a few breeding bulls. The actual cost of maintaining the herd amounted last year to Rs. 5,805 and all we got in return for the money was Rs. 1,190, of which Rs. 700 represented the value of the milk and Rs. 490 the price

of the animals sold during the year. To this income might be added the value of the cowdung which might be valued at about one thousand rupees, more or less.

On the other hand, it is to be borne in mind that the Patna breed as well as the crosses between that breed and the Khasi and Bhutia cattle have proved remarkably well adapted to the Khasi Hills and they are far superior, both as regard size and milking capacity, to any cattle we possess in Assam. It would be extremely undesirable, therefore, to abolish the herd of Patna and cross-bred cattle on the farm. There is a proposal to establish a special cattle breeding farm in Assam, and when it comes into being it may be found possible, in the interests of economy, to transfer the herd thereto.

A large number of pure Patna and cross-bred breeding bulls has been sold to Khasia breeders and others during the last decade. We do not know how all these bulls have done, but recently we made an enquiry about the condition and work of the bulls sold since 1911. Some of the animals are reported to have proved useful and given satisfaction to the owners, some died within a short time after their removal from the farm, and a few proved useless for breeding purposes.

Sheep breeding.

17. On 30th June 1914 the total number of sheep on the farm was 136 against 171 on the corresponding date of the preceding year. The flock was made up as follows:—

	1914.	1913.
Dumba rams	2	5
„ ewes	11	10
„ ram lambs	2	...
Khasi ewes	37	63
„ rams	2	6
Dumba × Khasi rams	12	4
Ditto ewes	26	17
Ditto ram lambs	...	26
Ditto ewe lambs	...	21
Dumba × Khasi × Dumba rams ...	17	3
Ditto ewes ...	8	1
Ditto ewe lambs ...	7	6
Ditto ram lambs ...	...	9
Dumba × Khasi × Dumba × Khasi ram lambs.	2	...
Ditto ditto ewe lambs	1	...
Dumba × Khasi × Dumba × Dumba ewes	3	...
Nepali ram	1	...
Nepali × Khasi ewe lambs	3	...
Ditto ram lambs	2	...
Total ...	136	171

The Nepali ram is private property and has been kindly lent to the farm by the owner for breeding purposes.

The results of sheep breeding last year were very disappointing. The flock instead of increasing decreased by no less than 35 animals. The decrease was due wholly to heavy mortality. No less than 95 sheep died from various causes, chiefly cold and bowel diseases, while only 65 lambs were born. The corresponding figures for the preceding year were 56 deaths and 95 births.

The sheep breeding experiment seemed promising in the beginning, but it is becoming clear that the climate and grass of the Khasi plateau do not suit sheep well. The grass though plentiful in summer is wanting in nutrition. The sheep do not put on flesh quickly as they ought to do if the grass were good, and it has been found necessary to supplement it with artificial food and even then they do not thrive well. The long spells of wet weather, often accompanied by cold, are particularly harmful to the sheep, and many animals have died from exposure.

Only three breeding rams, all being Dumba × Khasi, were sold during the year as against 6 in the previous year. The price charged for each ram was Rs. 8.

Ninety-nine sheep were shorn last spring and gave a total outturn of 63 lbs. of wool. The heaviest fleece was obtained from the Nepali ram, but it weighed only 1½lbs. The Dumba and cross-bred sheep gave about a pound of wool each. Samples of wool from the last clipping were forwarded to the Director-General of Commercial Intelligence, who was kind enough to get them appraised by Messrs. Ralli and Brothers of Calcutta. The valuations are quoted below :—

"*Sample A. Wool of pure Dumba sheep.*—"White, fair quality and staple, some kemp and grey, greasy, a little frib and earth.

"Value 7½*d.* per lb.

"*Sample B. Wool of pure Khasi sheep.*—"White, coarse in quality, rather short in staple, some grey, much grease and kemp, some frib and earth.

"Value 5½*d.* per lb.

"*Sample C. Wool of Dumba × Khasi sheep.*—"White and grey, fair quality and staple, some grease and kemp, a little frib and earth (sample shows about 20 per cent. of grey).

"Value 7½*d.* per lb.

"*Sample D. Wool of Dumba × Khasi × Dumba sheep.*—"White, medium quality, fair length of staple, some kemp and grease, a little grey and earth.

"Value 8*d.* per lb.

"*Sample E. Wool of Dumba* × *Khasi* × *Dumba* × *Dumba*—"White and grey, fair quality and staple, some grease, a little earth (sample shows about 50 per cent. grey).

"Value 8*d.* per lb.

"*Sample F. Wool of Nepali sheep.*—"White, coarse, good length of staple, some kemp, rather much grease, some grey and earth.

"Value 7½*d.* per lb.

"We may remark that all the wool shown is of a saleable character in this market."

These valuations are encouraging, but regard being had to the very small weight of the fleece, it is very doubtful if it would pay to shear the sheep.

Distribution of seeds and implements.

18. The following were the seeds, plants, implements, and spraying materials supplied to agriculturists during the year—

	Mds. srs.	Number
Seed-potatoes	804 23	...
Maize	5 0	...
Fruit grafts	...	12
Mulberry cuttings	...	24
Strawberry suckers	...	400
Copper sulphate for spraying	1 7½	...
Spraying pump	...	1
Turn wrest ploughs	...	3

N.B.—1 md. = 80 lbs. roughly.

Of the 804 mds. 23 srs. of seed-potatoes sold during the year, 615¼ maunds was supplied to Khasia cultivators, 10 maunds was sent to the Political Officer on the North-East Frontier, 25½ maunds to Honorary Correspondents in the plains, 20 maunds to the Superintendent of Lushai Hills, 20 maunds to the Subdivisional Officer of Mokokchang in the Naga Hills, and the remainder was supplied to private individuals outside the Khasi Hills, some of it going as far as Bengal and the Central Provinces. The sale of three turn wrest ploughs costing Rs. 40 to Rs. 50 indicates the growing appreciation of this implement by the more well-to-do among the Khasi cultivators.

Establishment.

19. The establishment consists of a Farm Superintendent on Rs. 100—10—200, a Fieldman Clerk on Rs. 50, a Mali on Rs. 12 and a Peon on Rs. 9 per mensem. The staff also includes an Overseer on Rs. 40, but he is employed exclusively on demonstration work and has no

direct connection with the farm. Besides there are two apprentices under practical training on an allowance of Rs. 15 each per mensem.

There were no changes in the staff during the year. The apprentices are appointed for two years. One of the two existing apprentices will complete his term of training at the end of October 1914 and the other on 31st May 1915.

The Farm Superintendent, Mr. L. Herrick Singh, continued to work well.

Receipts and expenditure.

20. The total receipts, excluding receipts from bonemeal and spraying of Bordeaux mixture, amounted to Rs. 4,018, of which Rs. 2,444 was by sale of potatoes, Rs. 897 by sale of milk and Rs. 360 by sale of cattle. The receipts in the previous year were Rs. 3,449.

The total expenditure, excluding the pay of the Overseer, which is now debited to demonstration, was Rs. 14,952-15-1 against Rs. 20,600 in the preceding year. The decrease is mainly attributable to the fact that in 1912-13, a large amount was spent on petty construction and reclamation under which there was comparatively little expenditure in the year under report. A part of the decrease was due to economy in management.

SHILLONG;

The 25th August 1914.

B. C. BASU,

Special Officer, Agricultural Department, Assam.

ANNUAL REPORT ON THE FRUIT EXPERIMENT STATION, SHILLONG, FOR THE YEAR ENDING THE 30TH JUNE 1914.

1. *Introductory.*—The fruit station commenced work in October 1912. It is situated on the south side of the Jowai road distant about a mile from Shillong. The elevation of the land is about 5,100 feet. The total area of the grant is 47·90 acres of which 15 to 20 acres are suitable for fruit planting. Three-fourth of an acre has been added to the "Lower Garden" laid out in 1912-13 bringing the planted area of the block to 4¼ acres. The soil of this block varies from light sandy loam lying above stone, to heavier loam of good depth.

The trees planted in 1912-13 required little winter pruning, and what was necessary to be done was finished by the 15th January. The majority of the Bush Apple trees put on a good growth during the year. The Standard and Espalier trees transplanted later, made little start before the spring this year, but since then they have put on very satisfactory growth. The Pyramid and Bush Pear trees took a long time to start, and the new growth last year was twiggy. This year the majority of the trees have thrown out strong growth. The Cordon, and the Upright trained trees are all thriving. A small percentage of the Plum trees are still backward; the remainder started this spring and are now doing well.—The Cherry, Peach, and Fig trees are now full of vigour.

All the trees were winter sprayed with Lime Sulphur Solution and have been summer sprayed with a weaker solution this year. Spraying for Aphis was done as necessary. Methylated spirit rubbed in where woolly apple Aphis had attacked the trees has proved a successful remedy.

No parasitic fungoid diseases have yet been discovered on the trees. The cause of the few cases of constitutional troubles met with, has in nearly all cases been traced to woolly Aphis at the roots of the apple trees and to the Cockchafer grub at the young roots of the trees. Vaporite, an insecticide, rids the soil of many insects, and this year has been used before planting.

The experiments made with Superphosphate of Lime Sulphate of Potash and Sulphate of Ammonia as recorded on page 7 in the report for the year ending the 30th June 1913 were repeated this year on the same trees.

The wall Fan trained trees planted this year have made a good start. The Currant and Gooseberry bushes started well but have been at a standstill since May. It remains to be proved if they can be grown successfully in this climate. Loganberry and similar fruits are sending up strong canes and as far as can yet be judged, will thrive.

The fruit of the Laxtonberry, a cross between the Loganberry and the Raspberry, has the real Raspberry flavour and no core. Pyne's Giant Himalaya Berry of California is a large Blackberry. It differs from other "Berries" of this class by bearing fruit on the old wood which continues to bear for years and has not to be cut back each season. It is an extra strong grower. The 7 varieties of American Vines planted, are said to succeed when grown in the open, in a climate where the rainfall is heavy.

Only a few apples were allowed to remain on the trees this year, sufficient to judge of the quality of the fruit. Of the culinary varieties, Red Victoria, a very highly coloured early fruit, shows promise of cropping well. Of mid-season varieties, Bismarck appears to be a heavy cropper. Of the late varieties, Bramley's Seedling, Alfriston, Lane's Prince Albert and Newton Wonder all carry good sound fruit. Of the dessert varieties, James Grieve, and Lady Sudeley are decidedly good. The Kerry Pippin promises to be a heavy cropper and the fruit though small is of good flavour. The Alexander, Peregrine, and Duke of York peach trees, bore good well coloured fruit in June, ripening well on the trees. All the hilly portion of the land has been stone terraced and there has been little loss of soil. A small plot of red clover was planted as an experimental cover crop for the land and has grown to a height of 2 feet before flowering. The tillage of the land began early in March, and the entire surface of the orchard was kept stirred once a month during the year to September. The early tillage saved the moisture in the soil. April as a rule, is a very dry windy month. This year March was dry. A good fall of rain during the first week of April was most beneficial to the growth of the young trees. A dry April would probably ensure a better crop of fruit to bearing trees. Dryness at the roots would check the root action and cause the trees to flower more profusely. Bees are kept for the purpose of fertilisation.

2. 1913-14, *Extension.*—Work on this commenced in October, 1913. A block of about 12½ acres of forest on a higher level to the east of the "Lower Garden," was selected for this extension. Of this area which has been designated "The Upper Garden," 10¼ acres have been planted in 5 blocks, *viz* :—

Top block.—Area 1¾ acres planted with bush apple trees, 15′ × 15′ diagonally.

North block.—Area 1½ acres planted with Standard Apple trees 34′ × 34′ diagonally, interplanted with Bush Apple trees 17′ × 17′.

South block.—Area ¾ acre planted with Bush Apple tree 15′ × 15′ diagonally.

East block.—Area 5½ acres planted with Standard Apple trees 34′ × 34′ diagonally, interplanted with Bush Apple trees 17′ × 17′.

West block.—Area 1 acre planted with Standard Pear trees 25′ × 25′ diagonally, interplanted with Bush Pear trees 12′ 6″ × 12′ 6″.

The remaining 2¼ acres cleared on the North-east, and West blocks will be planted during 1914-15.

The whole area of 12½ acres has been fenced with Page's wire fencing. The soil is a good loam of about 12 inches depth, lying on a reddish sub-soil. A small area only has a hard pan sub-soil about 2½ feet from the surface.

Practically the whole of the planted area will have to be terraced to prevent denudation of the soil by rainfall. Earth, banks in addition to the stone terracing have been made on the East block with satisfactory result. Before planting, the land was trenched to the depth of about 2½ feet and the top spit was left as near the surface as possible—all stumps and roots were removed. For each fruit tree 10 seers of slaked lime, and about the same quantity of wood ash were mixed with the soil in a circle 8 feet in diameter to the depth of the trenching. It has been proved that lime is effective against insect and fungus attacks on trees and for promoting soil fertility. Lime rubble as used in the Lower Garden was not procurable. The fruit trees were purchased from Messrs. Thomas Rivers and Sons, Sawbridgeworth Herts; Messrs. Stuart Low and Co., Bush Hill Park, Middlesex; Messrs. Seabrook and Sons, Chemsford, Essex; Messrs. H. Merryweather and Sons Limited, Southwell, Notts; and Messrs. Stark Bros., Louisiana, Missouri U. S. A. The Blackberry canes were purchased from George Pyne, Topsham, Devon. The majority of the trees arrived in good condition. The first consignment arrived on the 5th February and the last consignment on the 13th April. Planting was finished on the 28th May. The trees have started well, and there will be few vacancies or weak trees to replace.

The two Khasi apprentices did all the planting under my direction and work very satisfactorily.

Establishment consists of an Overseer on a monthly salary of Rs. 25 ; 5 Khasi gardeners on a monthly salary of Rs. 15 each ; and a Bengalee gardener on a monthly salary of Rs. 12. With training the Khasi makes a good gardener.

Three iron roofed houses on the Upper Garden and on the Lower Garden have been built for the staff. In each house a room has been reserved for use as a godown for stores and implements.

3. *Varieties planted.*—The following statement shows the number and varieties of fruit trees planted.

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1.	2	3	4	5	6	7	8	9	10
Apple trees ...	James Grieve ...	61	78	148	58	6	48	399	Bush.
	Boston Russet ...	...	...	12	...	...	...	12	
	Bens Red	...	...	10	10	...	9	29	
	Alfriston	...	...	30	...	...	10	40	
	Egremont Russet ...	10	...	...	10	...	...	20	
	Annie Elizabeth ...	...	...	10	...	...	...	10	
	Claygate Pearmain ...	10	...	...	10	...	...	20	
	Lord Hindlip ...	...	...	10	...	...	...	10	
	Mannington Pearmain	6	...	...	10	4	...	20	
	Winter Queening of Kent.	...	...	10	...	...	...	10	
	Pineapple Russet ...	...	...	...	10	...	...	10	
	Edward VII ...	...	...	...	10	...	...	10	
	Red Juneating ...	6	...	...	6	...	10	22	
	Flower of Kent ...	...	...	8	...	...	...	8	
	Barnack Beauty ...	...	...	...	6	6	...	12	
	Coronation ...	...	...	6	...	...	...	6	
	Wealthy	...	...	...	6	6	...	12	
	Feltham Beauty ...	...	...	10	...	...	...	10	
	Norfork Beauty ...	10	...	...	10	...	10	30	
	Christmas Pearmain	...	...	10	...	...	...	10	
	Yorkshire Beauty ...	5	...	...	5	...	...	10	
	Kings Acre Pippin ...	...	...	6	...	...	...	6	
	Crimson Bramley ...	15	...	20	...	...	5	40	
	Royal Snow ...	...	...	10	...	...	...	10	
	Bramleys Seedling ...	15	...	15	...	...	14	44	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees	Houblon	...	...	6	...	...	...	6	Bush.
	Roundway Magnum Bonum.	6	...	...	...	...	6	12	
	Wellington ...	...	...	6	...	...	...	6	
	Lanes Prince Albert...	15	...	15	...	...	10	40	
	Stirling Castle ...	10	...	10	...	...	...	20	
	Golden Russet ...	...	...	6	...	...	...	6	
	Charles Ross ...	10	...	10	...	...	...	20	
	Bismarck	...	...	15	...	...	6	21	
	Rymer	6	...	...	...	...	...	6	
	Warners King ...	...	...	...	...	...	12	12	
	Thomas Rivers ...	10	...	...	...	...	...	10	
	Grenadier ...	...	...	10	...	...	...	10	
	Rev. W. Wilks ...	20	...	...	...	...	6	26	
	Hounslow Wonder ...	...	...	21	...	...	6	27	
	Newton Wonder ...	15	...	15	...	...	10	40	
	Red Victoria ...	...	...	...	...	...	10	10	
	Potts Seedling ...	5	...	5	...	...	10	20	
	Hector McDonald ...	...	...	20	...	...	10	30	
	Domino ...	15	...	...	...	...	...	15	
	Rival ...	...	...	16	...	...	...	16	
	Wadhurst Pippin ...	10	...	...	...	...	...	10	
	Court Pendu Plat ...	...	...	6	...	...	...	6	
	Ecklinville Pippin ...	5	...	5	...	...	...	10	
	Early Red Margaret...	...	...	10	...	...	...	10	
	Gascoynes Scarlet ...	5	...	5	...	...	...	10	
	Spitzenberg ...	...	...	6	...	...	...	6	
	Braddicks Nonpareil	6	...	...	...	...	...	6	
	White Nonpareil ...	10	...	...	...	...	...	10	
	Baumann's Reinette...	6	6	...	...	...	...	12	
	Pitmaston Pineapple	10	...	...	...	...	...	10	
	Brownlees Russet ...	6	...	...	...	...	...	6	
	Sturmer Pipin ...	6	6	...	...	...	9	21	
	Court Pendu Plat ...	6	...	...	...	...	...	6	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees	Williams Favourite	10	...	...	...	...	...	10	Bush.
	Scarlet Nonpareil	...	...	10	...	...	16	26	
	Reinette doree de Heusgen.	10	...	...	...	...	...	10	
	Coe's Golden Drop	...	...	...	...	...	6	6	
	Cox's Orange Pippin	...	...	...	...	24	...	24	
	Kerry Pippin	...	10	10	...	...	10	30	
	Sansparell	...	...	...	...	6	...	6	
	Golden Reinette	...	...	...	...	...	6	6	
	Peasgood Nonesuch	...	...	24	...	6	6	36	
	Fearns Pippin	...	...	12	...	...	6	18	
	Lady Sudeley	...	...	20	...	4	6	30	
	Devonshire Quarrenden	...	...	...	...	...	18	18	
	Duke of Devonshire	...	...	...	...	6	...	6	
	Yellow Ingestre	...	...	...	...	...	6	6	
	Allens Everlasting	...	...	...	...	6	...	6	
	Ardcairn Russet	...	...	6	...	...	5	11	
	Allington Pippin	...	16	...	...	4	...	20	
	William Crump	...	...	12	...	...	6	18	
	Worcester Pearmain	...	...	...	...	6	...	6	
	Herrings Pippin	...	...	3	...	...	1	4	
	Beauty of Bath	...	...	6	...	6	...	12	
	Ellison Orange	...	...	...	...	...	1	1	
	Ribston Pippin	...	...	...	...	12	...	12	
	Charles Eyre	...	...	3	...	...	1	4	
	Syke House Russet	...	...	...	...	6	...	6	
	Spring Ribston Pippin	...	2	8	...	...	...	10	
	Mr. Gladstone	...	...	7	...	5	...	12	
	Golden Spire	...	14	...	...	...	...	14	
	Rosemary Russet	...	...	6	...	6	...	12	
	Early Peach	...	10	...	...	...	...	10	
	Yellow Newtown Pippin.	...	4	8	...	6	...	18	
	American Mother	...	9	...	...	...	...	9	

Species of fruit trees.	Variety.	Planted 1913-1914. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Encore	...	...	2	...	4	...	6	Bush.
	Irish Peach ...	...	6	...	...	...	...	6	
	Total ...	340	161	639	151	129	295	1,715	
	Crimson Bramley ...	...	...	...	10	...	...	10	Standards.
	Rhymer ...	...	...	...	...	...	8	8	
	Bramleys Seedling ...	...	...	8	14	...	...	22	
	Court of Wick ...	...	...	6	...	...	...	6	
	Irish Peach ...	...	...	...	6	...	...	6	
	Northern Greening ...	...	...	...	...	...	9	9	
	Norfolk Beefing ...	...	...	...	6	...	...	6	
	Newton Wonder ...	...	...	6	...	...	...	6	
	Sterling Castle ...	...	...	5	1	...	5	11	
	Duchess of Oldenburg ...	...	...	6	...	...	...	6	
	Norfolk Bearer ...	...	...	5	1	...	...	6	
	King of Tompkins County. ...	...	...	6	...	...	...	6	
	Emperor Alexander ...	...	...	...	6	...	...	6	
	James Grieve ...	...	...	12	...	...	...	12	
	Cox's Pomona ...	...	...	2	4	...	...	6	
	Smalls Admirable ...	...	...	6	...	...	...	6	
	New Hawthorden ...	...	...	6	...	...	...	6	
	Delicious (Starks) ...	...	...	12	...	...	...	12	
	King David ,, ...	...	...	12	...	...	...	12	
	York Imperial ,, ...	...	...	6	...	...	...	6	
	Paragon Winesap ,, ...	...	...	6	...	...	...	6	
	Jonathan ,, ...	...	...	6	...	...	...	6	
	Black Ben ,, ...	...	...	6	...	...	...	6	
	Champion ,, ...	...	...	3	...	...	...	3	
	Stayman Winesap ,, ...	...	...	6	...	...	...	6	
	Senator ,, ...	...	...	6	...	...	...	6	
	Grimes Golden ,, ...	...	...	5	...	...	...	5	
	McIntosh Red ,, ...	...	...	3	...	...	...	3	
	Mother ,, ...	...	...	6	...	...	...	6	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Early Melon (Starks)	...	...	6	...	...	...	6	Standards.
	Wealthy (,,)	...	...	12	...	...	...	12	
	Wilson's Red June (Starks).	...	...	6	...	...	...	6	
	Liveland Raspberry (Starks.)	...	...	6	...	...	...	6	
	Total ...	...	...	175	48	...	22	245	
	James Grieve ...	...	...	...	...	4	...	4	Horizontal trained
	Lady Sudeley ...	2	...	...	...	3	...	5	
	Gascoyne's Scarlet ...	3	...	...	...	...	...	3	
	Brownlees Russet ...	3	...	...	...	2	...	5	
	Beauty of Bath ...	...	...	...	...	5	...	5	
	Cox Orange Pippin	...	...	...	...	...	1	1	
	Cox Pomona ...	1	...	...	...	3	...	4	
	King of the Pippins	...	...	...	...	...	2	2	
	Kerry Pippin ...	...	...	...	...	...	1	1	
	Claygate Pearmain ...	...	...	...	...	...	1	1	
	Total ...	9	...	...	...	17	5	31	
	Scarlet Golden Pippin	...	...	...	...	...	2	2	Upright trained.
	Allington Pippin ...	...	...	...	...	...	2	2	
	Beauty of Bath ...	...	...	...	...	...	2	2	
	James Grieve ...	...	...	...	...	...	2	2	
	Barnack Beauty ...	...	...	...	...	...	2	2	
	Total ...	...	...	...	...	...	10	10	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	West block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Pear trees	Fertility ...	...	50	...	...	20	70	Bush and Pyramid.
	St. Swithins ...	...	...	...	...	10	10	
	Beurre Hardy ...	...	10	...	...	...	10	
	Red October ...	...	...	...	...	10	10	
	Beurre d' Anjou ...	...	6	...	...	...	6	
	Parrot ...	...	...	...	...	10	10	
	Williams Bon Chretien ...	...	9	...	...	...	9	
	Seedling Bergamot ...	...	...	...	...	6	6	
	Fondante Thirriot ...	...	12	...	...	10	22	
	Dr. Hogg ...	...	...	...	...	9	9	
	Triomphe de Vienne ...	...	5	...	...	...	5	
	Beacon	...	...	...	...	9	9	
	Beurre d' Amanlis ...	...	6	...	...	10	16	
	Beurre de Naghan ...	...	...	...	...	6	6	
	Charles Ernest ...	...	6	...	...	...	6	
	Rosevelt ...	...	...	...	...	6	6	
	Doyenne d' Ete ...	...	12	...	...	...	12	
	Blickling ...	...	...	...	...	6	6	
	Gansels Bergamot ...	...	6	...	...	...	6	
	Santa Claus ...	...	...	...	...	6	6	
	Josephine de Malines ...	...	6	...	...	10	16	
	Precoce de Juillet ...	...	...	...	...	6	6	
	Dr. Jules Guyot ...	...	6	...	...	6	12	
	Madame Treyve ...	...	...	...	...	10	10	
	Durondeau ...	...	6	...	...	6	12	
	Hessie ...	...	5	...	1	13	19	
	Beurre d'Amanlis ...	...	6	...	...	...	6	
	Emile Heyst ...	...	5	...	...	10	15	
	Marie Benoist ...	...	6	...	...	...	6	
	Clapps Favourite ...	...	5	...	...	10	15	
	Louise Bonne of Jersey ...	...	5	...	...	...	5	
	President Barabe ...	...	6	...	...	...	6	
	Total ...	...	173	...	2	189	369	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	West block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total Number.	Description.
1	2	3	4	5	6	7	8	9
Pear trees	Beurre Hardy ...	...	10	...	...	5	15	Single Cordon.
	Clapps Favourite ...	...	10	...	...	...	10	
	Durondeau ...	...	10	...	...	...	10	
	Madame Treyve ...	...	10	...	...	...	10	
	Williams Bon Chretien	...	10	...	...	5	15	
	Marguerite Marillat ...	...	10	...	...	5	15	
	Doyenne du Comice ...	...	10	...	...	5	15	
	Louise Bonne of Jersey	...	10	...	...	5	15	
	Conference ...	...	10	...	...	5	15	
	Emile Heyst ...	...	10	...	...	...	10	
	Winter Nelis ...	...	6	...	...	...	6	
	Beurre Superfin ...	...	...	...	...	5	5	
	Princess	...	...	...	...	5	5	
	Beurre Diel ...	...	...	...	...	5	5	
	Beurre d' Anjou ...	...	...	...	...	5	5	
	Total ...	...	106	...	...	50	156	
	Duchess d' Angouleme	...	2	...	...	...	2	Horizontal trained.
	Clapps Favourite ...	...	2	...	...	...	2	
	Josephine de Malines	...	2	...	...	...	2	
	Emile Heyst ...	...	2	...	...	...	2	
	Louise Bonne of Jersey	...	1	...	1	...	2	
	Beurre Superfin ...	...	1	...	1	...	2	
	Conference ...	...	2	...	...	...	2	
	Dr. Jules Guyot ...	...	2	...	...	...	2	
	Durondeau ...	...	2	...	...	...	2	
	Pitmaston Duchess ...	...	1	...	1	...	2	
	Fondante d' Automne ...	...	1	...	1	...	2	
	Doyenne du Comice...	...	2	...	...	...	2	
	Winter Nelis ...	4	...	...	...	...	4	
	Total ...	4	20	...	4	...	28	

Special of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	West block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Pear trees	King Karl (Starks) ...	...	3	...	...	...	3	Standards.
	Triumph ,, ...	...	4	...	...	...	4	
	Anjou ,, ...	...	4	...	...	...	4	
	Lincoln ,, ...	...	2	...	...	...	2	
	Howell ,, ...	...	4	...	...	...	4	
	Duchess ,, ...	...	5	...	...	...	5	
	Bartlett ,, ...	...	6	...	...	...	6	
	Seckle ,, ...	...	4	...	...	...	4	
	Marie Louise ...	...	2	...	...	...	2	
	Conference ...	...	2	...	...	...	2	
	Emile Heyst ...	...	2	...	...	...	2	
	Madame Treyve ...	...	2	...	...	...	2	
	Louise Bonne of Jersey	...	2	...	...	...	2	
	Princess	...	2	...	...	...	2	
	Doyenne du Comice ...	...	2	...	...	...	2	
	William Bon Chretien	...	2	...	...	...	2	
	Souvenir du Congres...	...	2	...	...	...	2	
	Marie-Louise d' Uccle	...	2	...	...	...	2	
	Total ...	...	52	...	...	...	52	
	Conference ...	...	...	...	...	3	3	Upright trained.
	Marie Louise d' Uccle	...	...	...	...	4	4	
	Louise Bonne of Jersey	...	...	...	...	4	4	
	Fondante d' Automne...	...	...	...	...	3	3	
	Winter Nelis ...	...	...	...	4	...	4	
	Conseiller de la Cour...	...	...	...	...	3	3	
	Doyenne du Comice...	...	...	...	...	3	3	
	Total ...	...	...	...	4	20	24	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Plum trees ...	Late Transparent ...	...	...	...	...	6	...	6	Bush.
	Denniston's Superb Gage.	...	...	...	...	...	10	10	
	Satsuma	...	...	...	...	1	...	1	
	Belle de Louvain ...	...	...	...	...	...	6	6	
	Greengage ...	...	...	...	...	6	5	11	
	Cox's Emperor ...	...	...	...	...	...	6	6	
	Starks Gold ...	3	...	...	...	...	...	3	
	Belgian Purple ...	...	...	...	...	...	10	10	
	Rutland Plumcot ...	1	...	...	...	...	...	1	
	Ponds Seedling ...	...	...	...	...	...	6	6	
	Starks Shiro ...	1	...	...	...	...	...	1	
	Early Transparent ...	...	...	...	...	...	6	6	
	Starks Omaha ...	...	...	1	...	2	...	3	
	Autumn Beauty ...	...	...	1	...	...	5	6	
	Guthries Late Gage ...	...	...	...	...	...	5	5	
	Reine Claude de Bavay	...	...	...	...	...	5	5	
	Victoria ...	...	...	...	...	...	9	9	
	Czar	...	...	...	...	...	6	6	
	Starks Mammoth Gold	...	...	1	...	...	...	1	
	King of the Damsons	...	...	...	...	3	...	3	
	Starks Imperial Gage	...	...	1	...	...	...	1	
	White Damson ...	...	...	...	...	3	...	3	
	Brune Shropshire ...	...	...	...	...	3	...	3	
	Merryweather Damson	...	...	...	...	6	...	6	
	Starks America ...	...	...	2	...	...	...	2	
	Total ...	5	...	6	...	30	79	120	
	Decaise ...	...	...	...	...	1	...	1	Fan trained.
	Kirkes ...	...	...	...	...	2	...	2	
	Jefferson ...	...	...	...	...	2	...	2	
	Denniston's Superb Gage	...	...	...	...	1	...	1	
	Mallard ...	...	...	...	...	1	...	1	
	Golden Esperen ...	...	...	...	...	1	...	1	
	Oullins Golden Gage	...	...	...	...	2	...	2	

Species of fruit trees.	Variety.	Planted 1913-1914. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Plum trees ...	Reine Claude d' Althan	...	...	...	...	1	...	1	Fan trained.
	Early Transparent ...	...	...	...	...	1	...	1	
	Coes Golden Drop ...	...	...	...	...	1	...	1	
	Transparent Gage ...	...	...	...	...	1	...	1	
	Greengage ...	...	...	...	...	2	...	2	
	Golden Transparent Gage.	...	...	...	...	1	...	1	
	Belgian Purple ...	...	...	...	...	1	...	1	
	Total ..	...	...	...	...	18	...	18	
Cherry trees ...	Morello ...	...	...	...	...	...	2	2	Trees.
	Kentish ...	...	...	...	...	...	20	20	
	Bigarreau Kentish ...	...	...	...	...	...	6	6	
	Gloire de France ...	...	...	...	...	...	6	6	
	White Heart ...	...	...	...	...	...	6	6	
	Napoleon ...	...	1	...	...	...	...	1	
	Black Heart ...	...	...	...	...	...	6	6	
	Lambert ...	...	1	...	...	...	...	1	
	Montmorency King ...	...	1	...	...	...	1	2	
	Montmorency Monarch	...	3	...	...	...	...	3	
	Turkey Black Heart ...	...	...	...	...	1	...	1	Fan trained.
	Late Black Bigarreau	...	...	...	...	1	...	1	
	Frogmore Bigarreau...	...	...	...	...	1	...	1	
	Noir de Guben ...	...	...	...	...	1	...	1	
	Belle de St. Tronc ...	...	...	...	...	1	...	1	
	Early Rivers ...	...	...	...	...	1	...	1	
	Total ...	...	6	...	...	6	47	59	
Orange trees ...	Japanese Satsuma ...	...	...	...	...	2	...	2	Trees.
	Japanese Kumquot ...	...	4	...	...	8	...	12	
	Malta Blood ...	...	4	...	...	3	2	9	
	St. Michael's ...	...	...	...	...	4	...	4	
	Jaffa ...	...	...	...	...	1	3	4	
	Malta Oval ...	...	...	...	...	2	1	3	
	Silver ...	...	1	...	...	1	3	5	
	Excelsior ...	...	...	...	...	2	...	2	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Orange trees ...	St. Michael's Tangierin.	...	...	...	...	...	6	6	
	St. Michael's Dom Louise.	...	...	...	...	3	...	3	
	St. Michael's Sustain...	...	...	...	...	1	1	2	
	Ditto Achilles	...	...	...	...	...	1	1	
	Total ...	...	9	...	...	27	17	53	
Lemon trees ...	Imperial Lemon ...	...	...	...	...	...	2	2	
	Total ...	...	...	...	...	...	2	2	
Walnut trees ...	Dwarf Prolific ...	...	...	...	...	...	10	10	
	Total ...	...	...	...	...	...	10	10	
Peach trees ...	Peregrine	...	...	...	...	5	14	19	Trees.
	Alexander ...	...	...	...	...	3	11	14	
	Duke of York ...	...	...	...	...	1	16	17	
	Exquisite	...	...	...	...	...	4	4	
	Late Devonian ...	...	...	...	...	3	...	3	
	Lady Palmerston ...	...	...	...	...	3	...	3	
	Duchess of Cornwall ...	...	...	...	...	1	...	1	
	Early Rivers ...	...	...	...	...	1	...	1	
	Gladstone	...	...	...	...	1	...	1	
	Golden Rathripe ...	...	...	...	...	1	...	1	
	Sea Eagle	...	...	...	...	1	...	1	
	Alexander Noblesse ...	...	...	...	...	1	...	1	
	Waterloo ...	...	...	...	...	1	...	1	
	Thamas Rivers ...	...	...	...	...	1	...	1	
	Goshawk	...	...	...	...	1	...	1	
	Total ...	...	...	...	...	24	45	69	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apricot trees ...	Superb (Starks) ...	...	2	...	....	2	....	4	Trees.
	Blenheim	...	....	...	....	6	....	6	
	Wenatchee Moorpark (Starks).	...	1	...	....	...	....	1	
	Total ...	...	3	...	....	8	....	11	
Fig trees ...	White Marseilles ...	...	...	...	...	...	5	5	
	Bourjassotte Grise ...	...	...	...	...	...	5	5	
	Monaco Bianco	...	...	...	....	...	6	6	
	Total ...	...	....	...	....	...	16	16	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	West block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Wineberry	.....	...	...	...	1	...	1	Berries.
Lowberry...	.....	...	...	...	...	6	6	
Newberry...	.....	...	...	...	1	...	1	
Loganberry	.....	...	...	...	3	1	4	
Phenomenal	.....	...	...	...	3	1	4	
Laxtonberry	.....	...	...	...	5	...	5	
Blackberry	Pyne's Giant Himalaya Berry of California.	...	...	...	12	...	12	
Raspberry...	Pyne's Royal ...	...	...	...	6	...	6	
Strawberry	Gevon's late Prolific...	...	...	...	...	900	900	Plants.
Ditto ...	Louis Gauthier ...	...	...	...	...	350	350	
	Total ...	...	...	...	...	1,250	1,250	
Currant bushes.	Raby Castle ...	...	...	...	6	...	6	Fan trained.
	White Dutch ...	...	...	...	6	...	6	
	Scotch Red ...	...	...	...	6	...	6	
	Boskoop Giant Black	...	...	...	2	...	2	
	Defender Black ...	...	...	...	1	...	1	
	Mervin Crystal White	...	...	...	6	...	6	
	Southwell's Black ...	...	...	...	23	...	23	
	Total ...	...	...	...	50	...	50	
Gooseberry trees.	Golden Drop Yellow...	...	...	...	5	...	5	Gridiron trained.
	Keepsake Green ...	...	...	...	6	...	6	
	Whinhams Industry Red.	...	...	...	3	...	3	
	Couzens Seedling Yellow.	...	...	...	4	...	4	
	Total ...	...	...	...	18	...	18	
Nut trees...	White Filbert ...	...	...	...	3	...	3	Trees.
	Red Filbert ...	...	...	...	3	...	3	
	Prize Cob ...	...	...	...	3	...	3	
	Kentish Cob ...	...	...	...	3	...	3	
	Total ...	...	...	...	12	...	12	

Species of fruit trees.	Variety.	Planted 1913-14. Upper garden. Top block.	West block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Grape Vines.	Campbell's Early (Starks).	...	...	...	2	...	2	Vines.
	Hicks (Starks)	...	...	...	2	...	2	
	King „ ...	...	...	...	2	...	2	
	Eclipse „ ...	...	...	...	2	...	2	
	King Phillip „ ...	...	...	...	2	...	2	
	Wilder „ ...	...	...	...	2	...	2	
	Worden „ ...	...	...	...	2	...	2	
	Total ...	...	...	...	14	...	14	

Summary of Fruit Trees planted to 30th June 1914.

—	1912-13.	1913-14.	Total.
1	2	3	4
Bush Apple trees	295	1,420	1,715
Standard „	22	223	245
Horizontal trained Apple trees ...	5	26	31
Upright „ „	10	...	10
Bush and Pyramid Pear trees ...	189	179	368
Single Cordon „ ...	50	106	156
Horizontal trained „ ...	...	28	28
Standard „ ...	...	52	52
Upright trained „ ...	20	4	24
Bush Plum trees	79	41	120
Fan trained Plum trees	...	18	18
Cherry trees	47	12	59

—	1912-13.	1913-14.	Total.
1	2	3	4
Orange trees	17	36	53
Lemon „	2	...	2
Walnut „	10	...	10
Peach „	45	24	69
Apricot „	...	11	11
Fig „	16	...	16
Wineberry	...	1	1
Lowberry	6	...	6
Newberry	...	1	1
Loganberry	3	1	4
Phenomenal	3	1	4
Laxtonberry	...	5	5
Giant Himalaya Blackberry ...	...	12	12
Raspberry	...	6	6
Strawberry plants	1,250	...	1,250
Currant Bushes	...	50	50
Gooseberry trees	...	18	18
Nut trees	...	12	12

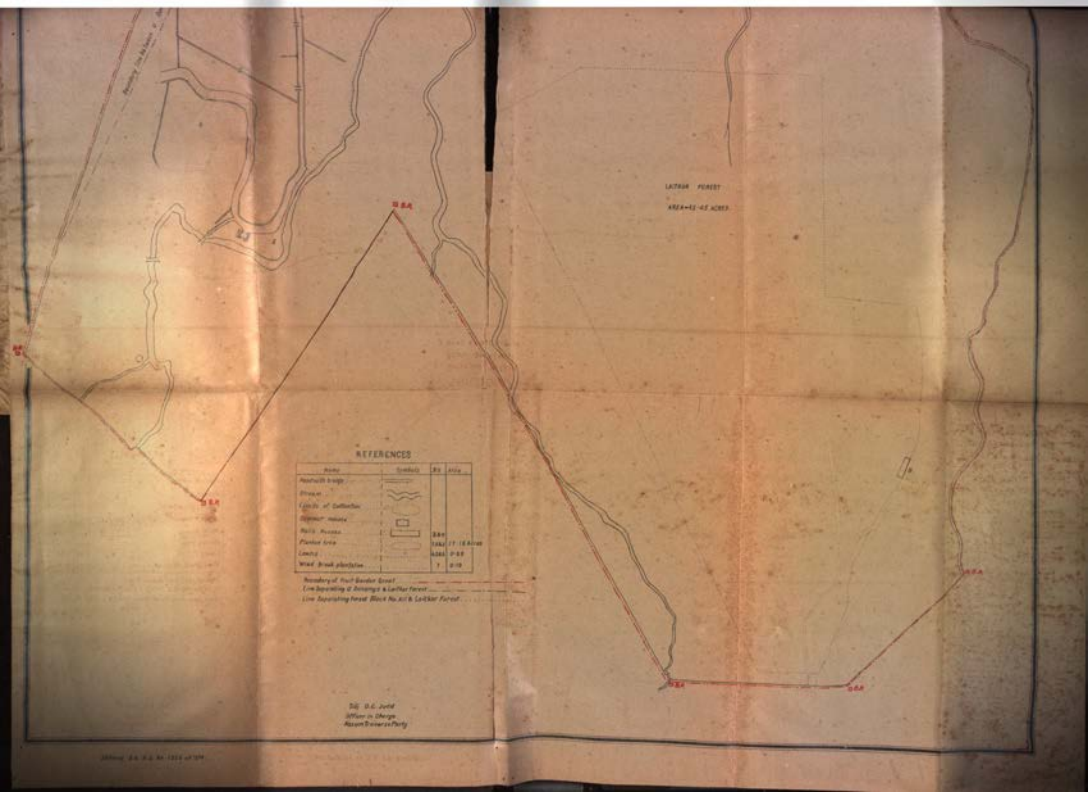
C. H. HOLDER,

The 29th July 1914. *In charge, Fruit Experiment Station, Shillong.*

Statement showing the Receipts and Expenditure of the Fruit Experiment Station, Shillong, from 1st July 1913 to 30th June 1914.

Receipts.	Amount.	Expenditure.	Amount.
1	2	3	4
	Rs, a. p.		Rs. a. p.
Sale proceeds of Timber ...	1,095 2 0	Allowance to Superintendent	3,000 0 0
		Establishment ...	1,348 0 0
		Petty Construction ...	3,891 1 6
		Seeds, plants and manures	3,453 7 9
		Instruments, appliances and machinery.	757 0 9
		Chemicals insecticide ...	238 5 6
		Wages of labourers ...	11,874 13 6
		Other charges ...	2,411 15 0
		Cost of Timber to Forest Department.	4,787 1 0
Total receipts ...	1,095 2 0	Total expenditure ...	31,761 13 0

FRUIT EXPERIMENT STATION
SHILLONG
Surveyed 1913-14
Scale 64 = 1 Mile
Area 47.100 ACRES
From Shillong
Forest B.P.
LAITKOR FOREST
AREA=45.42 ACRES
B.A.


LATHAR FOREST
AREA=42·45 ACRES
REFERENCES
Footpath bridge
Stream
Limits of Cultivation
Different nature
Rock Access
Planted area
Limits
Wood Break plantation
Boundary of Hill Garden Forest
Line Separating G. Jaintapia & Lachar Forest
Line Separating Forest Block No. II & Lachar Forest
Sd/ D.E. Judd
Officer in Charge
Assam Boundaries Party

ANNUAL REPORT OF THE KARIMGANJ AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING 30TH JUNE 1914.

General.

The Karimganj experiment station or farm which is also known as the Sylhet Agricultural station came into being about the middle of the year under report. Rice being the most important staple of the district, it is proposed to devote the station principally to experimental work on that crop. The station is situated on the Sylhet road, 3½ miles to the west of the subdivisional town of Karimganj, which lies on the Assam-Bengal Railway.

In selecting the site of the farm, care was taken to make it as typical as possible of the great rice-plains of Sylhet. The land is well adapted for the cultivation of the chief classes of rice grown in the district. These include autumn or *aus* rice, both broadcast and transplanted, winter or *sail* rice which is always transplanted, and a class of rice known as *asra* which comprises the comparatively short-stemmed varieties of deep water winter rice (*aman*). The only kinds of rice for which there is no suitable land on the farm are those varieties of broadcast winter rice (*aman*), which are grown in very deep water, and another class known as *boro* which is grown in the dry season on the margin of swamps and tidal rivers. There is no land in the farm which is low enough to grow these two classes of rice.

The land appears to be well suited to the cultivation of jute ; but it is proposed not to take up this crop until the work with rice is well advanced.

The total area of the farm is a little under 80 acres. Out of this area, a compact block of about 8 acres has been set apart for the farmstead and quarters for the farm staff.

The land which was private property has been acquired at a cost of Rs. 46,900-7-3. The average price paid including the statutory compensation of 15 per cent. was Rs. 591 per acre. It was only in January last that the Department was able to take possession of the land and the last three months of the financial year was mainly taken up in equipping the place with such appurtenances as were absolutely necessary before any agricultural work could be commenced.

2. The soil on the greater portion of the farm is a deep fertile alluvial clay of fine texture, though not particularly heavy. In the higher lands it partakes more of the nature of a loamy soil. The soil has not yet been chemically analysed.

Character of land and soil.

The land slopes away from the Longai river which flows close by, but the slope is so gentle as to be barely perceptible to the eye. A level survey has been made with the object of enabling us to lay out the cultivated area in fields and plots of uniform level. The difference in level is only about three feet between the highest and the lowest points of the farm. The lowest parts of the farm ordinarily remain under one to three feet of water during the rainy season. The higher lands do not usually go under water and have to be embanked to keep in the rain water. In very high floods the farm receives the overflow of the Longai river and the whole area then goes under water varying in depth from one to four feet; but such high floods happen only once in many years. One such occurred in July last year.

3. The equipment of the station is still far from being complete. Ten pairs of country plough cattle were purchased during the year at an average cost of slightly under Rs. 100 per pair. At least five more pairs will have to be purchased.

Equipment.

A large amount of petty construction work was done during the year. The works constructed and their cost were as follows:—

	Rs.
Quarters for the Farm Superintendent ...	2,250
,, Fieldman-Clerk	750
Godown	2,200
Nine sheds for cattle and coolies	395
Two tanks for drinking water	1,250
Two roads 1,525 feet long	200

All the works were executed under departmental management.

Several more houses remain to be built and one more tank to be dug. A more urgent work is the fencing of the farm. It is proposed to use the 'Ideal woven wire fence.' It is hoped these works will be completed before the close of the current financial year.

Crops and experiments.

4. The farm also needs to be laid out in fields and plots of suitable size and uniform level for purposes of experimental cultivation. A level survey of the farm has been made for this purpose at a cost of about Rs. 250. The work of laying out the land will be undertaken as soon as the rice crop now on the ground has been removed.

The land having been taken up at the close of the last agricultural season, no crops were harvested during the year under report. Since March last, a considerable portion of the farm has been sown with non-experimental rice which is now on the ground. Towards the close of the year, an experiment in line breeding of rice was initiated in consultation with the Deputy Director and Mr. G. P. Hector, the Economic Botanist of Bengal, who kindly came over to Karimganj to advise us. The object of this important experiment is to produce improved seed for distribution to the raiyats. Ordinary rice seed is generally found on examination to be a mixture of different types of unequal quality and productive power. Our method of breeding will consist in growing as many varieties of rice as we can procure and in selecting from among the types found those which on testing will be found to breed true and prove more prolific and of better quality all round than other types within the same class and eventually in growing the selected types on a field scale to obtain seed for distribution.

Receipts and expenditure.

5. There were no receipts during the year under report. The total expenditure exclusive of the cost of acquisition of the land amounted to Rs. 11,309-14-5 and was distributed as follows :—

	Rs.	a.	p.
Establishment	1,198	0	0
Implements	100	0	0
Purchase of cattle	997	8	0
Feed of cattle	51	2	0
Seeds, plants and manures	181	9	9
Wages of labourers	469	13	10
Petty construction	6,913	14	0
Reclamation	575	8	7
Country implements and petty repairs ...	272	14	0
Furniture	146	8	0
Stamps and telegrams	30	6	0
Unspecified charges	372	10	3
Total ...	11,309	14	5

Staff.

6. The sanctioned staff of the farm consists of—

One Farm Superintendent on Rs. 100—10—200;

One Overseer on Rs. 30—2—50;

One Fieldman-Clerk on Rs. 25—1-8—40;

One peon on Rs. 8;

and four apprentices, of whom two are to be appointed annually for a period of two years on an allowance of Rs. 10 per month in the first year, and of Rs. 12 per month in the second.

The post of Overseer has not yet been filled up, and only two out of the 4 apprentices have been appointed. Babu Rukmini Mohan De, a graduate of the Nagpur Agricultural College, who had been serving as a fieldman-clerk at the Upper Shillong farm, has been appointed Superintendent of the Farm with effect from the 1st April 1913. He will remain on probation for two years from that date, and during probation his pay has been fixed at Rs. 75 during the first year and at Rs. 80 during the rest of the term. Babu Nirod Behari Sarma has been appointed fieldman-clerk with effect from 1st April 1914.

SHILLONG,
The 21st July 1914.

B. C. BASU,
Special Officer, Agricultural Department, Assam.

REPORT ON THE KAMRUP SUGARCANE EXPERIMENT FOR THE YEAR ENDING JUNE 30TH, 1914.

Introductory.—India is the biggest sugar-producing and at the same time the biggest sugar-consuming country in the world. The annual production in round numbers amounts to 3 million tons, while the annual consumption is about $3\frac{3}{4}$ million tons, leaving a deficit of $\frac{3}{4}$ million tons, which is met by importation of crystalline sugar from Java and other sugar-producing countries.

Under orders from the Government of India the question of sugar production in India came up for discussion at the conference of the Board of Agriculture held at Pusa in November 1911.

Full details of the recommendations made at the conference will be found in the official report of the Board of Agriculture published by the Government of India. It is sufficient to state here that one of the recommendations was that Provincial Agricultural Departments should make enquiries and report as to the suitability of areas of waste land for sugarcane, with a view to the establishment of the central factory system. The central factory system can be worked in two ways, one by locating the factory in the centre of a cane growing tract, and purchasing cane from the surrounding cultivators, and the other by taking up a tract of waste land and cultivating cane on a large scale to supply the factory. The first way is only possible in a densely populated tract with good communications, and therefore in a thinly populated province such as Assam the second method is the only feasible one. Accordingly a rough survey of some of the tracts of waste land in Kamrup and Goalpara was made in 1912-13, and certain areas in north Kamrup along the Bhutan frontier were reported as being *primâ facie* suitable for sugarcane growing on a large scale.

Subsequently, at the instance of the Agricultural Adviser to the Government of India to whom the report was submitted, proposals for the initiation of an experiment in sugarcane cultivation by means of steam tackle were put forward by the local Agricultural Department, and approved by the Assam Administration and the Government of India. Briefly it is proposed to take up an area of 1,000 acres more or less, and grow cane with the aid of steam cultivation with the object of ascertaining at what cost per maund cane can be produced. It is estimated that if cane can be produced at 5 annas or less per

maund* the manufacture of white sugar by a large factory will yield a handsome profit. It is however no part of the scheme to build and equip a factory. In the event of the experiment proving successful, it is intended to hand over the concern to capitalists, who will increase the area under cane and build a sugar factory on the spot. Funds have been provided for carrying on the experiment for three years, but if at any time before the termination of this period the public are satisfied that sufficient proof of success has already been obtained, our object will have been attained and no time will be lost in disposing of the concern.

The experiment proper has not yet been commenced, as the steam tackle is not expected before the beginning of next cold weather. In the meantime, however, in order to provide planting material, a certain amount of cane has been planted this year near the site by bullock power cultivation, and this preliminary report deals with what has been done up to date. On the arrival of the steam tackle it is proposed to open up, in the first instance, as large an area as can be planted with the material available, and probably about 150 acres will be planted next spring.

2. *Land.*—The tract chosen for the experiment is situated in North Kamrup, and is bounded on the north by the Bhutan Hills, south by Cachari villages, east by the new Pagladiya river, and west by the Kooklibari road. The greater portion is high land at present carrying grass jungle from 10 to 15 feet high. There are occasional swamps, which could however be fairly easily drained, since the fall from the hills to the south is from 15 to 20 feet per mile. Allowing for swamps, river beds and uncultivable land, there should be an area approaching 50,000 acres available for sugarcane cultivation in this tract, Irrigation, should it be required, could be arranged either from the numerous streams or from wells.

The actual site of the experiment is about 15 miles to the north of Nalbari station, Eastern Bengal State Railway, between the new and old Pagladiya rivers, and near villages Khagrabari and Tapilagaon. It is estimated that between these two rivers there is an area of at least 5,000 acres of high land suitable for cane, exclusive of at least an equal area to the south of this which could be made suitable by draining.

3. *Soil.*—The soil of the high land varies from good medium loam to sandy loam on a sandy sub-soil. In a few places the sand comes near the surface, but usually there is from 1 to 3 feet of good soil, while in the swamps the soil is stiff on a stiff sub-soil,

* One maund = 82 lbs.

although it is probable that sand would be reached at no great depth. Except on the few sandy patches the soil is dark brown or black in colour, which usually denotes a good supply of organic matter. On the whole the soil is a good loam, easily worked and very suitable for cultivation.

4. *Communications.*—The site is approached from Nalbari station by a public road northward to Garhbithar village some 10 miles, where a village track leads off to Khagrabarigaon. About 3 miles of this track has been improved temporarily, and a new track made from this point to the site, a distance of some 2½ miles, at a cost of Rs. 728. These measures are only temporary, as the work had to be hurried through in order to facilitate carting. During the ensuing cold weather it is proposed to make a permanent road from Garhbithar to the present site, and extend it about two miles northwards to the proposed site of the steam tackle experiment.

5. *Buildings, tanks, fencing, etc.*—A sum of Rs. 330 was spent on temporary buildings of bamboo and thatch, including a cattle shed, rest house, sheds for coolies and a godown. A tank for supply of water to the cattle was excavated at a cost of Rs. 75. One mile of Ideal wire fencing, including four corner posts and gate, was purchased at a cost of Rs. 1,761.

6. *Cattle and Implements.*—Ten pairs of bullocks were purchased at Sonepur in November at a total cost of Rs. 1,626, including freight and attendance, etc. The following implements were imported from Messrs. Ransomes of Ipswich :—

2 four feet disc harrows,

3 Turn-wrest ploughs,

2 double mould board ploughs,

1 Cambridge roller,

from Messrs. Burn & Co.—

2 toothed chain harrows,

and from Messrs. Arthur Butler & Co.—

3 Spring tyned harrows.

The total amount spent on implements, including a few of country make, was Rs. 1,077.

7. *Preparation of land.*—It was intended at first to plant 40 acres of the three best varieties of cane grown at the Jorhat Experiment Station. Accordingly a square with side of 440

yards was set out in January and the grass burnt. Owing to the rawness of the bullocks and the fact that the land contained a mass of grass roots, it was found impossible to break up the land with the plough, so it was done with the hoe. Hoeing was finished on February 26th. The next operation was to reduce the clods with the disc harrows, which were put over twice; then laddering and collecting of roots, etc., then ploughing 8 inches depp with the turn wrest plough; then harrowing again with disc harrows twice and in some parts with spring tyned harrows in addition ; and finally laddering and collecting roots, etc., where necessary.

The fact that the newly purchased bullocks had not been broken to the yoke made these processes extremely laborious, and it was some weeks before much progress could be made. In order to help with the work, a pair of trained bullocks was borrowed from Jorhat and another pair from the Shillong farm; these were subsequently returned.

8. *Material for planting.*—In order to ensure a supply of good cane of proved varieties, the whole of this was obtained from the Jorhat Farm in Upper Assam. After harvesting, the cane was weighed, made into bundles weighing about 100 lbs. and wrapped in thatching grass. It was then carted 10 miles to the Railway. By special arrrangement with the Assam-Bengal Railway the trucks were attached to passenger trains and despatched straight through to Nalbari station on the Eastern Bengal State Railway. From there the cane was carted 15 miles to the site of the experiment.

In all eleven consignments consisting of 1,315 bundles weighing over 60 Tons were despatched in this way, and all arrived within a week, except two consignments, which owing to a misunderstanding, were sent further down the line.

The total cost of packing and transport of cane was Rs. 2,118.

9. *Planting.*—The land was divided into four blocks each 620 feet square, leaving a space of 20 feet all round the outside of the area, and 40 feet between the blocks. Furrows about 6 inches deep and four feet apart were made from north to south with the ridging ploughs, and whole canes were laid end to end in the furrows. Women and children then covered them up to a depth of about 2 inches. This system of planting gave approximately 17½ rows to the acre, so it was found convenient to miss one row after every eighteenth, leaving a space of 8 feet and thus forming plots of just slightly over an acre in area.

Owing to the supply of cane at Jorhat giving out, a total area of only 23 acres could be planted. This was made up as follows :—

B. 147	...	...	9·8 acres.
B. 376	...	...	7·7 „
Striped Mauritius	...	...	5·5 „
	Total	...	23·0 acres.

Planting was commenced on March 3rd and was finished on April 20th.

10. *Other crops.*—On the remaining area the following crops were sown for trial :—

Cotton.—Buri and Garo Hills varieties ·86 acre each, sown beginning of May.

Groundnuts.—Four varieties, *viz*, Raipur, Poona, Big Japan and Verginia, sown on small areas at beginning of May.

Green manure crops.

Indigo.
Cowpeas, 5 varieties.
Dhaincha.
Sann.
Soybeans.

11. *Expenditure.*—

	Up to 31st March.	From April 1st to 30th June.	Total.
1	2	3	4
	Rs. a. p.	Rs. a. p.	Rs. a. p.
Purchase of cattle	1,626 9 9	...	1,626 9 9
„ Implements	1,077 6 0	...	1,077 6 0
Petty construction	2,896 0 6	...	2,896 0 6
Seeds	1,566 6 0	552 6 0	2,118 12 0
Labour	1,499 11 3	474 14 3	1,974 9 6
Cattle food	249 0 3	212 2 6	461 2 9
Postage	...	5 0 0	5 0 0
Miscellaneous	782 12 5	269 10 0	1,052 6 5
Total ...	9,697 14 2	1,514 0 9	11,211 14 11

Expenditure under "Petty construction" included :—

	Rs.	a.	p.
Fencing	1,761	12	0
Roads	728	8	0
Buildings	330	12	6
Tank	75	0	0

and that under "Seeds" includes cost of packing and freight on cane from Jorhat.

12. *Staff.*—Up to the close of the year no regular staff had been appointed. A trained demonstrator from Jorhat was deputed to assist in the work which was closely supervised by the Agricultural Supervisor, who spent the greater part of his time there from November to the end of the year under report. The Deputy Director personally supervised the work as much as his other duties, which included the supervision of three other experiment stations, allowed. Mr. A. A. Meggitt, Agricultural Chemist, and the Farm Superintendent, Jorhat, arranged for the packing and despatch of canes from Jorhat, and the District Agricultural Officer, Kamrup, took delivery at Nalbari and despatched to the site.

SHILLONG,
The 22nd August 1914.

A. G. BIRT,
Deputy Director of Agriculture, Assam.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE ASSAM VALLEY, DURING THE YEAR ENDING THE 30TH JUNE 1914.

Maulvi Fazlal Haq Ahmed, Agricultural Supervisor, was in charge, assisted by the District Agricultural Officer in Kamrup and two demonstrators in Sibsagar. Bireswar Das and Nabin Chandra Barua, the two demonstrators, were given permanent appointments on Rs. 25—1-8—40 from April 1st.

2. Manuring demonstrations with bonemeal and flour phosphate were made in ten centres in Sibsagar district and eight centres in Kamrup. In each centre 5 plots each approximately ⅓ acre in area were taken. One plot received 3 maunds (246 lbs.) bonemeal per acre, and another plot 3 maunds flour phosphate per acre, while the three remaining plots were untreated. In Sibsagar all the demonstrations were on one crop land. In Kamrup it was intended to make the demonstrations on two crop land (*ahu* followed by transplanted winter paddy) but this could only be arranged for in four centres. The Kamrup results were so erratic, due partly to unevenness of land and partly to washing out of manures by flood, that I do not propose to publish them.

Rice.

The results of the Sibsagar demonstrations are given in the following table :—

Sibsagar District.

No.	Locality.	Grain in lb. per acre.			Remarks.
		Bonemeal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6
		lbs.	lbs.	lbs.	
1	Lakwa	1,707	1,927	1,572	
2	Sibsagar	1,953	2,176	1,632	
3	Nazira	2,172	2,692	2,172	
4	Chikonidhora (Jorhat) ...	1,681	1,811	1,326	
5	Kakajan (ditto) ...	1,284	1,884	1,134	

No.	Locality.	Grain in lb. per acre.			Remarks.
		Bonemeal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6
		lbs.	lbs.	lbs.	
6	Cherengia (Jorhat) ...	1,446	1,422	1,062	
7	Kacharihat (Golaghat) ...	1,254	1,386	1,146	
8	Titabar	2,016	1,986	1,152	
9	Jhanzi	1,092	1,746	1,170	
10	Dergaon	...	...	...	Produce of plots mixed before weighment.

The flour phosphate plots in every case gave a substantial increase in yield over the untreated plots, the average increase being 518 lbs. paddy per acre valued at Rs. 15-12, while the cost of the treatment, taking price of the flour phosphate at Rs. 2-8 per maund, was only Rs. 7-8, leaving a net profit of Rs. 8-4 per acre on the first year.

The bonemeal plots gave an average increase of 249 lbs. paddy per acre valued at Rs. 7-8 over the untreated plots, while the cost of treatment, taking the price of the bonemeal at Rs. 3 per maund, was Rs. 9 per acre. This shows a net loss of Re. 1-8 per acre on the first year, but as the benefit of bonemeal has been found to last for 3 years, this loss should be converted into a handsome profit in the next two years.

Srijut Narayan Barua, Honorary Correspondent, Nakachari, made two rice demonstrations under the guidance of the Agricultural Supervisor. On a plot manured with 3 maunds per acre flour phosphate he obtained 3,444 lbs. of paddy per acre as against 3,378 lbs. on a plot treated with bonemeal, and 3,075 lbs. per acre on an untreated plot.

In another demonstration he obtained 3,210 lbs. paddy per acre by transplanting *two* seedlings in a bunch 15 inches apart, 2,961 lbs. by transplanting *three* seedlings in a bunch 15 inches apart, and 2,226 lbs. by transplanting 6 to 10 seedlings in a bunch in the ordinary local manner.

Sugarcane.

3. With the object of introducing to the notice of cultivators the superior varieties of cane grown at Jorhat Farm, demonstrations were made in the Sibsagar district, and the results of the first crop were given in

last year's report. This year the plots were ratooned, but owing to the small staff of demonstrators at our disposal we were unable to obtain weighments for the ratoon crop.

The reports received from the cultivators, however, shew that the results were satisfactory. These demonstrations have resulted in a very large number of applications from cultivators for planting material of the superior varieties, and steps are being taken to supply the demand. This year, owing to the fact that all surplus cane at Jorhat was required for planting at the new Kamrup sugarcane station, we were unable to meet the demand.

Srijut Thaneswar Sarma Barthakur of Mohokuti, Sibsagar, obtained cuttings of B. 147 from the Jorhat Farm and planted them alongside an equal area of the local variety. He kept a careful account of cost of cultivation and outturn of each plot with the following satisfactory results per acre :—

	B. 147.	Local variety.
	Rs. a. p.	Rs. a. p.
Total expenditure including cost of cultivation and *gur* making, etc.	136 14 0	102 0 0
	lbs.	lbs.
Weight of cane	40,846	22,140
Ditto of juice	22,801	10,608
Ditto of *gur*	4,674	2,043
	Rs. a. p.	Rs. a. p.
Value of *gur*	288 0 0	125 0 0
Profit	151 2 0	23 0 0

Demonstrations with three roller iron bullock power crushing mills were continued during the year. Nine mills were sent out in Sibsagar district and 6 mills in Kamrup. Five of these mills were sold during the year to the cultivators who had been using them. There is now a large demand for the mills from cultivators who hitherto had used only the country made wooden mills, but some agency is required for distribution and for making advances to enable the cultivators to purchase them. We find that the majority of cultivators are willing to take the mills only on the instalment system, and we have the greatest difficulty in recovering the money. With our present staff and funds, which are barely sufficient to carry on the demonstration work, it is impossible for the Agricultural Department to undertake this on a large scale. It would be, I think, a useful line of work for Co-operative Credit Societies to make advances for the purchase of mills, or to guarantee the recovery of the purchase money. The Agricultural

Department could then make arrangements for the supply of mills at convenient centres for sale to cultivators at cash prices. It is necessary, however, that all purchases should be on a strict cash basis so that the manufacturers can be paid without encroaching on the Agricultural Department funds. In this case the Department would simply be acting as agents.

Perhaps a better system would be for small capitalists to purchase a number of mills and let them out on hire. This system has been very successful in Bengal, where Messrs. Renwick & Co., have built up a large business. A man of Kamrup recently requested us to supply him with 50 mills next season for letting out on hire, and we have referred him to the manufacturers.

4. During the current year the demonstration work in the Assam Valley will be extended to include :—

(1) Green manuring for sugarcane.
(2) Conservation of cattle dung in covered pits.
(3) Sorghum (*jowar*) for fodder.
(4) Meston ploughs.
(5) Potato cultivation.

A. G. BIRT,

Deputy Director of Agriculture, Assam.

SHILLONG,

The 28th August 1914.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE KHASI AND JAINTIA HILLS DISTRICT, DURING THE YEAR ENDING THE 30TH JUNE 1914.

U Harry Singh, Overseer, Shillong, was in charge of this work, assisted by three temporary demonstrators. From April 1st two of the demonstrators, *viz.*, Hir Sing and S. N. Biswas, have been appointed to permanent posts on Rs. 25-1/8-40 per mensem, while the third, U Mellison, has since been transferred to the Garo Hills.

Rice.

2. Demonstrations, with the object of bringing to the notice of cultivators the advantage of applications of raw bonemeal, have been made for several years, in this district with such success that there is now a keen and increasing demand for bonemeal for this purpose, but the high price of bonemeal in this remote tract is tending to check the extension of the practice. It was hoped that the bonegrinding plant referred to in last year's report would be ready in time to produce a cheaper supply during the year under report, but unfortunately, owing to delay in delivery of some of the machinery, the plant was not ready in time, and we had to fall back on the dearer Calcutta supply. The total quantity sold this year was 141 maunds at Rs. 5-2-6 per maund. Of this, 80½ maunds were issued from the stock at the Upper Shillong Farm, and 60½ maunds from the depôt at Jowai.

This year demonstrations were made in ten centres. It was intended to have 5 plots each-⅓rd acre in area in each centre, one plot being manured with 3 maunds (246 lbs.) bonemeal per acre, another with 3 maunds (246 lbs.) flour phosphate per acre, the remaining three plots being left as controls. It was, however, only possible to arrange for the full number of control plots in three centres, there being only two control plots in each of three centres, and only one each in four centres.

The first year's results are given in the following table :—

No.	Place.	Cultivator.	Yield of grain in lb. per acre.			Remarks.
			Bonemeal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6	7
1.	Smit	Raja Dakhor Singh (Siem of Nhyrim.)	642	597	556	Damaged by storm.
2.	Umlyngka... ...	Kpa Ka Kwai... ...	1,939	1,616	631(a)	
3.	Mairang	Kmie Ka Selina ...	1,843	1,625	761	
4.	Kynshi	Ka Mar	1,617	1,486	990	
5.	Kheim Mawrah ...	Kpa U Rubin/... ...	1,605	1,402	727(a)	
6.	Mylliem	U Hira Shon	1,405	1,108	738(b)	
7.	Shangpung ...	U Simon Dhar... ...	1,601	1, 2 7	1,045(a)	Damaged by storm.
8.	Sutnga	U Lakon Barnon ...	986	735	492(b)	Ditto.
9.	Jowai	U Tamon Nikhla ...	1,353	1,328	1,265	Ditto.
10.	Mawlyngkneng ...	Ka Sngit Lawai ...	1,604	1,292	986(b)	

(a) Average of two plots.

(b) Average of three plots.

Leaving out of account the plots damaged by storms, the average yield per acre on the bonemeal plots works out at 1,669lbs. against 1,421 lbs. for flour phosphtae and 805 lbs. for the untreated plots. Thus the average increase over the untreated plots due to bonemeal is 864 lbs. and that due to flour phosphate is 616 lbs. of grain per acre.

Valuing the bonemeal at Rs. 5 and the flour phosphate at Rs. 4-8 per maund (82 lbs.) delivered at Shillong; and the paddy grain at Rs. 3 per maund, the bonemeal plots show a gross profit of Rs. 31-8 on an expenditure of Rs. 15 leaving a nett profit of Rs. 16-8 per acre, or over 100 per cent. while the flour phosphate plots show a gross profit of Rs. 22-8 on an expenditure of Rs. 13-8 leaving a nett profit of Rs. 9, or over 66 per cent.

It must not be forgotten that these results are for the first year only, and that previous experience has shown that bonemeal does not exert its full influence on the crop until the second year, and that its effect remains until the end of the third year. The value of the increased yields which are to be expected in the second and third years, therefore, will be nett profit, since no further expenditure is entailed.

These plots are being kept under observation, and the second and third years' results will be published in due course.

Potatoes.

3. The value of several of the imported varieties of potatoes grown at the Upper Shillong Farm is already well known to cultivators on the higher plateau of the Khasi Hills, and large amounts are sold annually for seed at market rates.

During the year under report, depôts for the sale of seed potatoes were opened in seven centres in the potato-growing tracts, *viz.*:—

(1) Upper Shillong Farm.

(2) Marbisu.

(3) Mawphlang.

(4) Dumpep.

(5) Cherrapunji (old village).

(6) Cherrapunji (new village).

(7) Lat Mawphlang.

The price at the farm was Rs. 3-4 per maund (82 lbs.), that being the average market rate at Shillong last season, while the price at the depôts was Rs. 3-4 plus cost of freight from the farm. The total quantity sold was 911 maunds, of which 804½ maunds were issued from the farm and 106½ maunds from the other depôts. With the exception of about 2 maunds the whole quantity sold consisted of King of potatoes and Farm Magnum Bonum 542 maunds of the former and 367 maunds of the latter.

At the request of some cultivators of Jowai in the Jaintia Hills, where potatoes are not generally grown, a demonstration of potato growing was made on the land of U Halikton Passah near Jowai village. The area taken for the demonstration was 4 acres. Cowdung was applied at the rate of 120 maunds per acre and 5 maunds of Magnum Bonum potatoes were planted in April. The crop was sprayed once in May with 120 gallons of Bordeaux mixture per acre. The crop was harvested during the second

work of July, when 25 maunds of tubers were obtained. The cost of cultivation was Rs. 64-14-0 including cost of "seed," and the value of the crop was Rs. 75 leaving a profit of Rs. 10-2, equal to Rs. 25-5 per acre. This result is not satisfactory as the profit per acre should have been at least double that obtained. The land was raw and the manuring was inadequate owing to scarcity of cowdung, and this told against the crop. It is proposed to repeat this demonstration next year under better conditions.

In last year's demonstration report an account is given of our attempts to popularize spraying of potatoes with Bordeaux mixture as a preventive of disease, by sending out trained sprayers with machines to spray the crops of cultivators at cost price. This system was continued this year, but very little could be done as the cultivators, although acknowledging the benefits due to spraying, are apparently not willing to pay hard cash to have it done. Consequently only 9 acres were sprayed this year as against 32 acres last year.

This year, owing to favourable weather conditions and also to the fact that the majority of the cultivators are now using seed of disease resisting varieties obtained from the farm, there was little or no disease, so it is not difficult to understand the attitude of the people towards spraying, although it has been proved many times that, even in the absence of disease, spraying prolongs the life of the plant resulting in a considerable increase of crop.

Grafting of fruit trees.

4. As in previous years, demonstrations in grafting were made in the villages by the demonstrators while on tour. This year the following grafts were made in 26 villages: —

Oranges	684	(budding)
Pears	63	grafts.
Apples	9	„
Peaches	61	„
Plums	13	„
Total	830	

Of the oranges budded, 256 were done on limes and wild citrus. The object of this is to check the orange disease which has been prevalent for many years on the southern slopes of the hills, and which has been referred to in previous reports. This disease so far has not been found on limes and wild varieties of citrus, so it is hoped that oranges budded on these stocks may prove immune. No sign of disease has appeared on any of the

budded oranges up to date, and one tree budded three years ago is now bearing fruit.

This is extremely important in view of the disease, which is reported to be gradually killing out the old orange groves, and for which no remedy has been found.

Spraying as a remedy for disease of "Pan."

5. In the Report of the Agricultural Department for the year ending 30th June 1913, mention is made of this disease and the remedial measures which were being tried. This work was continued during the year under report.

A garden which had been abandoned owing to the disease was taken for the experiment. It contained 56 betel vines nearly all of which were affected. The vines were sprayed twice, once in May and again in December, with Bordeaux mixture at a total cost of 11½ annas. Clearing of jungle was done at a cost of Rs. 1-8. In February only 42 plants were alive and nearly all of these still showed signs of disease.

Spraying was also tried in four other gardens with rather better results, but the owners report that the treated plants are not altogether free from the disease, although in some cases spraying was done three times.

Apparently once the disease attacks the stems of the plants spraying will not save them, and therefore all such plants should be immediately rooted up and burnt, since, if allowed to remain, they become a source of infection to healthy plants. If all cultivators could be induced to do this and at the same time to spray all remaining plants twice a year, there is reason to hope that the disease would be checked, if not got rid of altogether. It is proposed to continue the work on these lines, but with our limited staff of demonstrators everything depends on the co-operation of the cultivators.

Terrace cultivation.

6. With the object of checking "jhuming" on the steep gorges on the southern side of the Khasi Hills, about ½ acre of land in Maolot village was terraced in the cold weather of 1912-1913. The area was divided into three plots. The cropping in 1913 was:—

Plot I Raitrew (millet).
" II Maize.
" III Sweet potatoes.

The Raitrew and sweet potatoes were unmanured, while the maize received cowdung at the rate 200 maunds per acre. The Raitrew and maize produced *no crop at all*, and the sweet potatoes yielded only 152 lbs. valued at about Rs. 3.

The cropping in 1914 was :—

Plot No. I Sweet potatoes.
„ „ II Potatoes.
„ „ III–Raitrew.

The sweet potatoes and Raitrew were unmanured while the potatoes received 150 maunds cowdung per acre.

The potatoes have been harvested and yielded 136 lbs. tubers from 60 pound "seed." The sweet potatoes and Raitrew are still on the ground.

Cost of experiment to date—

	Rs.	a.	p.
Laying out terraces	62	8	0
Labour for this was given free by the villagers, and cost has been calculated by taking number of men employed at annas 8 per day.			
Tools	60	0	0
First year cultivation—			
Raitrew	8	0	0
Maize	4	12	0
Sweet potatoes	14	0	0
Total	26	12	0
Second year cultivation—			
Sweet potatoes	10	7	0
Potatoes	10	15	0
Raitrew	12	8	0
Clearing jungle	2	12	0
Total	36	10	0
Grand total	185	14	0

Against this we have total receipts of Rs. 7-3, for sweet potatoes Rs. 3 and potatoes Rs. 4-3. There is also the value of the sweet potataes and Raitrew now on the ground, but this is not expected to amount to much.

So far this experiment has been a decided failure, and it is very doubtful whether any dry cultivation on this system would be successful until the soil has become weathered. The preparation of terraces on the steep slopes necessitates great disturbance of the soil with the result that the raw sub-soil containing unoxidised substances poisonous to most plants is exposed, and until this is thoroughly oxidised by cultivation, and a sufficient amount of organic matter has been incorporated, no results can be expected. From the cultivator's point of view then, I consider that it would be disastrous for him to abandon his present method of cultivating dry crops and launch out into terrace cultivation.

Wet cultivation on terraces is, however, quite another question, and provided that there is a convenient water-supply near by, there is a possibility that wet rice cultivation would be successful, since it is a well known fact that rice thrives under soil conditions which are toxic to almost any other crop. Arrangements for the demonstration of wet rice cultivation on terraces will be made next year, but whether the cultivators will be disposed to abandon their dry crop *jhum* cultivation and go to the trouble of making terraces for wet rice cultivation remains to be seen. So long as they have a sufficient area to *jhum* over, I very much doubt it.

A. G. BIRT,

Deputy Director of Agriculture, Assam.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE SURMA VALLEY, DURING THE YEAR ENDING THE 30TH JUNE 1914.

There were twelve demonstrations made during the year in the Sylhet district, each at a separate centre, and all intended to show the effect of bonemeal and flour phosphate on the rice crop. These demonstrations had been commenced towards the close of the previous year, but the crops concerned belonged properly to the year under report. At each centre, a small block of land of apparently even quality and capable of growing two crops of rice in the year, namely, early or *aus* rice followed by winter or *sail* rice, was selected for the purpose of the demonstration. It was divided into three parts, one of which was manured with bonemeal at the rate of 3 maunds per acre, another with flour phosphate applied at the same rate as the bonemeal, and the third was left without any manure. The land belonged to private individuals and was cultivated and planted by them in their own way, the only new element introduced being the manures which were supplied to them free of cost. The manures were applied under the supervision of the District Agricultural Officer or of an Honorary Correspondent who voluntered to supervise the demonstration.

Unfortunately the majority of the demonstrations were spoiled by an exceptionally high flood which occurred in July 1913 and had to be abandoned. The flood not only destroyed the standing crop, but obliterated the effect of the manures by covering the land with a layer of silt. In only five places the flood was not severe enough to destroy the standing crop or to spoil the land wholly, and it was found possible to plant and reap both crops of rice on which the effect of the manures applied was to be tested. The results obtained at these five centres are exhibited in the following table :—

Locality.	Manure used per acre. A. Bonemeal 3 mds. B. Flour phosphate 3 mds. C. No manure.	Cost of manure used per acre.	Total yield of grain from two crops of rice per acre.	Excess of yield of manured over unmanured plots per acre.	Value of excess at Rs. 2-8 per maund of grain.	Profit + or loss—	Remarks.
		Rs a. p.	Mds srs. chs.	Mds. srs. chs.	Rs. a. p.	Rs. a. p.	
1. Bhanga	A ...	9 0 0	23 29 8	3 28 12	9 5 6	+0 5 6	
	B ...	7 8 0	25 11 8	5 10 12	13 2 9	+5 10 9	
	C ...	...	20 0 12	.....	.....	.....	
2. Barlikha	A ...	9 0 0	20 2 4	5 3 4	12 11 3	+3 11 3	
	B ...	7 8 0	20 38 8	5 39 8	14 15 6	+7 7 6	
	C ...	.....	14 39 0	.....	.....	.....	
3. Chunghar	A ...	9 0 0	22 24 12	6 19 6	16 3 6	+7 3 6	The land was considerably damaged by flood and both *aus* and *sail* were transplanted late.
	B ...	7 8 0	17 27 4	0 21 14	1 5 10½	—6 2 1½	
	C ...	.....	16 5 6	.....	.....	.....	
4. Gurabhui	A ...	9 0 0	12 28 0	2 35 0	7 3 0	—1 13 0	Ditto ditto.
	B ...	7 8 0	9 38 0	0 5 0	0 5 0	—7 3 0	
	C ...	.....	9 33 0	.....	.....	.....	
5. Shaistaganj	A ...	9 0 0	29 24 0	6 4 4	15 4 3	+6 4 3	The crop was damaged by insects to some extent.
	B ...	7 8 0	23 20 0	0 0 4	.....	—7 8 0	
	C ...	.....	23 19 12	.....	.....	.....	

It will be seen that the use of bonemeal gave a clear net profit in three out of the five. demonstrations ; in one the cost of the manure was barely recovered by the increase in outturn of grain. In one case only, the increase in yield due to the manure was not sufficient to cover its cost, but it will be noted that the crop was considerably damaged by flood and gave a much poorer outturn than in the other demonstrations.

The use of flour phosphate showed a net profit in two and a net loss in three places. This was a new manure and had not been tested in any previous experiment or demonstration.

Both bonemeal and flour phosphate are manures which dissolve slowly in the soil, and their effect is known to last for several years. It is expected that the fields to which these manures were applied last year will give an increased yield of grain in the current year.

It was found that the paddy which was obtained from the fields manured with bonemeal or flour phosphate weighed 12 to 14 per cent. heavier, measure for measure, than the produce of the land which had received no manure.

An experiment was started on the Baikunthapur garden under the direction of the Agricultural Chemist and the Deputy Director of Agriculture to test the effect of treating up-land soil with lime, bonemeal and flour phosphate. The Manager of the garden was to conduct the experiment, but he gave it up in the middle of the year; the experiment came in consequence to an untimely end.

One of our Honorary Correspondents, Maulvi Abdul Mannan Choudhury of Kanihati in the South Sylhet subdivision, was supplied with five maunds of Magnum Bonum seed potatoes from the Upper Shillong Farm. He planted a portion of the seed himself, and distributed the rest among his neighbours. The crops gave a fair outturn and left a handsome profit in each case after paying for the seed and manures used. It is expected that many cultivators of that neighbourhood will grow the Shillong variety of potatoes in the coming season.

In concluding this short note on demonstrations in the Surma Valley, I desire to mention that we are not yet in a position to undertake more than a very limited amount of demonstration work in the Surma Valley. Beyond the District Agricultural Officer we do not possess any staff at present for organizing and supervising demonstrations in that valley, and the cannot be expected to do much single handed. It is very necessary to provide him

with a number of trained fieldmen to help him in field work, but none will be available for two years yet. I do not expect any substantial help in the way of organizing or supervising demonstrations from our Honorary Correspondents or Associates. Our experience of them has not been very encouraging so far.

B. C. BASU,

Special Officer, Agricultural Department, Assam.

SHILLONG :
The 13th August 1914.

A. S. P. O. (D. L. B. & Agri.) No. 48—510—8-12-1914.

ANNUAL REPORT

ON THE

AGRICULTURAL EXPERIMENTS AND DEMONSTRATIONS

ASSAM

FOR THE

YEAR ENDING THE 30TH JUNE 1915.

SHILLONG:

PRINTED AT THE ASSAM SECRETARIAT PRINTING OFFICE

1915.

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ANNUAL REPORT OF THE JORHAT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1915.

Introduction.

This station is situated about 3 miles south of Jorhat, Sibsagar district, Assam Valley, and was established in the beginning of the year 1906. It was intended principally for sugarcane work. Since then, on account of peculiar soil conditions, which altogether precluded the growth of most *rabi* crops even in the presence of abundance of soil moisture, the work has been extended to include a study of the factors causing this sterile condition with a view to its amelioration. This work has been continued for six years, and we are now in a position to state that the sterile condition of the soil to most crops in the cold weather, and also to certain crops in the rains is due to the accumulation of acid substances, which are readily neutralised and rendered harmless by dressings of lime to the soil. A full account of the experimental results leading up to this conclusion has been published as a memoir of the Department of Agriculture, Chemical Series, Vol. III, No. 9, entitled "Studies of an Acid Soil in Assam."

In connection with the improvement of the soil by liming, the application of other fertilizers has been studied, and our regular scheme of manuring now includes green manuring and the application of raw phosphates.

The original area of the station was about 35½ acres, of which 1·7 acres is *hola* or ravine land and the remainder high land, which was under grass and scrub jungle at the time of acquisition. An additional area of about 24 acres has since been acquired, of which about 4 acres is *hola* land and the remainder high land. The total area at present is thus about 59½ acres. Most of the newly added area has been put under cultivation and is being treated uniformly in blocks with a view to future experiments.

Soil.

2. The soil of the high land is a reddish sandy loam of the old alluvium, lying on a hard greyish yellow sub-soil. Where the conditions have not been improved by cultivation, the soil is extremely shallow varying from only 3 to 6 inches in depth.

The following report is by Mr. A. A. Megitt, Agricultural Chemist, Assam :—

Report on analysis of Jorhat farm soil.

	Surface soil.	Sub-soil.
	Laboratory No. 5.	Laboratory No. 5(*a*).
1	2	3
	Per cent.	Per cent.
Soluble in Hydrochloric acid with 12 *hours, digestion at* 100°*C.*		
Phosphoric acid ($P_2 O_5$)	0·025	0·020
Potash ($K_2 O$)	0·115	0·135
Lime (CaO)	0·154	0·144
Magnesia (MgO)	0·166	0·148
Soluble in 1 *per cent. citric acid with 7 days' digestion.*		
Phosphoric acid	0·008	0·008
Potash	0·007	0·011
Loss on ignition (organic matter and combined water).	3·26	1·84
Nitrogen	0·114	0·051
Calcium carbonate	0·048	0·018
Reaction	Acid.	Acid.

Physical constants.

	Hygroscopic capacity.	Maximum water saturation capacity.		Minimum water saturation capacity.		Moisture in air dry soil.
		Per cent. of water in saturated soil by weight.	Per cent. of water in saturated soil by volume.	Per cent. of water by weight.	Per cent. of water by volume.	
1	2	3	4	5	6	7
Surface soil ...	3·10	31·9	50·5	11·2	13·9	1·2
Sub-soil ...	...	30·0	50·0	7·2	9·1	1·19

These analyses agree quite well generally with some others made some years ago by the Imperial Agricultural Chemist.

These samples are acid in reaction, and the total lime present in all combinations, as well as the carbonate of lime, is quite deficient in quantity.

Carbonate of lime has an enormous influence on a soil's welfare chemically, physically and bacteriologically.

Its effect on soil biological processes are in the right direction, and very great; it also influences the texture of soils in a remarkable way, and is active in bringing into use the reserves of dormant plant food. Its presence in fair amount also ensures the most economical effect of any manuring given. Its absence forbids the use, for most cropping, of certain kinds of manures, unless liming be first resorted to.

Any upland soil containing such small amounts of total lime and lime carbonate as are here present will most certainly respond markedly in the case of most cropping to applications of lime.

The amount of organic matter is probably greater than obtains in many Indian soils, but there is no doubt that a light soil of this character will be much improved in many ways by an increase in the amount of humus.

A good deal of the organic matter present is of a doubtful character and consists very probably of very old residues of little value; it is the presence and active decay of comparatively recent additions of organic matter which puts life into a soil.

The percentage of nitrogen present in the surface soil is what would normally be considered a fair one, but in view of the absence in anything like adequate quantity of carbonate of lime, conditions for nitrification are probably not as favourable

as they might be by a long way, and an increase in the amount of nitrogen is indicated as desirable.

Of potash there is no dearth, and there would seem to be no immediate need for potash manuring.

Regarding phosphoric acid, these samples show a deficiency both in total as well as available supplies. There is thus a "real" as opposed to a mere temporary lack in respect of this element of plant food.

This lack of phosphoric acid is further aggravated by the absence of sufficiently large amounts of lime carbonate and humus, high percentages of which may, and often do, offset a smaller percentage of phosphoric acid.

An acid condition of soil, besides being harmful in itself, very often brings about a more rapid depletion of the soil's stock of phosphoric acid, in consequence of which most soils of a decidedly acid character are found to be lacking in this element and to respond to its suitable application.

Turning to the physical constants, the hygroscopic capacity is low, and about what one would expect for this class of soil. It means that only water which is in excess of about 3 per cent. is available for crops, and plants are able to reduce the soil moisture content to somewhere about this figure before they begin to wilt. The top 6 inches of soil even during the cold weather normally contains a good deal more moisture than 3 per cent. when under a close standing crop, so that usually there is sufficient water for the crop's requirements.

As regards maximum saturation capacity, these soils agree quite well with quoted figures for similar soils in Europe, and suggest that the optimum proportion of water for the growth of the plant is about 13 to 16 per cent. A recent determination of soil moisture in the surface 6 inches of the soil of this farm in August, some few hours after rain, gave 17 per cent. water. Soil moisture conditions are therefore probably extremely favourable for growth during the rainy season.

The figures for minimum saturation capacity are much lower than those cited (Hall, The Soil, page 69) for similar soils in Europe, and this is probably due to the lower content of humus which obtains in our soils. This is an extremely important figure in gauging a soil's power to retain a reserve of moisture for crops during dry periods.

The sub-soil is worse in this respect than the surface layer, suggesting that the incorporation of organic matter, if it can be buried sufficiently deep, will have a great ameliorating effect.

The sub-soil is capable of very great improvement indeed as the figures show, but it would probably be immediately disastrous to work it so deeply as to bring any considerable amount to the surface at once.

The growth of deep-rooting legumes as green crops will assist materially, but if the sub-soil could be stirred occasionally, while at the same time the surface cultivation is gradually deepened so that green crops may be more deeply buried, a greater depth of surface soil will result, which on this farm is very much to be desired.

I am convinced that for cane cultivation, until the surface soil has been deepened and the amount of humus increased, it is of little use attempting manurial experiments on cane with artificial manures. No amount or combination of the latter can ever make up in the case of a crop like sugarcane for loss of fertility due to shallow cultivation and lack of "humus."

Buildings and machinery, etc.

3. The farm is equipped with a godown, combined office and rest-house, quarters for Farm Superintendent, Fieldman clerk and apprentices, and a cattle shed with brick walls and corrugated iron roof. A three roller 12″ × 18″ cane mill driven by a 9 B.H.P. Hornsby oil engine was installed in 1911.

During the year the Farm was completely enclosed by Ideal wire Fencing.

A Dutch Barn, 40′×20′, with corrugated iron roof and brick floor, and also a threshing floor 40′×40′ brick-on-edge and cement pointed, were constructed during the year at a cost of Rs. 2,891.

Rainfall.

4. The rainfall recorded during the growing period of the crops referred to is given in the following table together with the normal rainfall :—

Month.	Actual rainfall in inches.	Normal rainfall in inches.
1	2	3
1914 April	5·67	8·54
„ May	7·99	9·26
„ June	6·01	11·36

Month.				Actual rainfall, in inches.	Normal rainfall, in inches.
1				2	3
1914 July ...	...	...	...	15·42	14·76
„ August...	...	...	...	15·88	15·15
„ September	...	...	...	9·96	9·18
„ October	...	...	...	1·16	4·07
„ November	...	...	...	0·48	0·69
„ December	...	...	...	0·00	0·52
1915 January	...	...	...	0·23	0·93
„ February	...	...	...	2·40	1·32
„ March ...	...	...	...	3·07	3·90
		Total	...	68·27	79·68
„ April ...	...	...	...	7·71	8·54

Remarks.

The annual fall will be seen to be nearly 12 inches below normal. The chief shortage occurred from April to June when the deficiency was 10 inches. Very little rain fell after the end of September.

The season was otherwise normal, though the cold weather was shorter and not so cold as usual.

Experimental work.

5. The work of previous years was continued and extended under the following heads :—

I, Sugarcane experiments.

II, Soil Investigations.

III, Trials of new crops.

6. Owing to the large amount of cane required for demonstration and distribution purposes this year, only in a very few cases could the whole of each variety plot be experimentally treated. In every case however the whole of the cane, stripped as for milling, was weighed. About half of this cane was in most cases crushed, and the juice thus obtained sampled and analysed. The bulk of juice thus sampled from each plot for analysis was the product of from 1 to 2 tons of cane.

Sugarcane.

The figures appearing in Tables I to VIII are calculated from the results of the analysis of the 1 to 2 ton sample of cane, combined with the actual weight of cane stripped for milling, from the whole of each plot.

7. The following varieties planted in Block D in 1913 were ratooned :—

Sugarcane varieties. Ratoon cane.

B 147
Striped Mauritius
B 376
} ¼ acre duplicate plots.

Magh
B 208
} $\frac{1}{10}$ acre plots.

The results of the plant cane crop appeared in last year's annual report. After the harvest of the plant cane early in 1914, all pieces of dead and diseased canes were removed and burnt, and the land was hoed. Following usual practice, two earthings were subsequently given, and the crop received 30 mds. rape cake per acre, half at the first earthing and half at the second. Stripping was done at the commencement of the cold weather. For the first time for many years the local variety of cane, *Magh*, produced a small ratoon crop of some 11½ tons of cane per acre. This is probably connected with the undoubted decrease in the incidence of attacks by cane Borer and other diseases on this Farm within the past year or two, following preventive measures taken, the chief of which are improved drainage and the burning of dry trash on the field after harvest. The results are set out in Tables I and II, of which Table I shows the composition of the juice and Table II the weights of cane, juice, sugar, etc., per acre.

TABLE I.

Block D. Ratoon cane, 1914-15 (Varieties.)

Juice.

Plot.	Variety.	Plot area.	Cane Sugar.	Invert sugar.	Total sugar.	Glucose Ratio.	Total solids.	Purity co-efficient.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	
1	B 147 ...	¼	17·48	0·47	17·95	2·70	18·75	93·2	
2	Striped Mauritius.	¼	14·37	1·03	15·40	7·18	16·29	88·2	Plot 2 was badly lodged, hence comparatively low quality of juice.
3	B 376 ...	¼	15·93	0·64	16·57	3·98	17·23	92·4	
4	B 147 ...	¼	17·49	0·45	17·94	2·57	18·51	94·4	
5	Striped Mauritius.	¼	15·99	0·73	16·72	4·59	17·39	91·9	
6	B 376 ...	¼	16·65	0·49	17·14	2·96	17·54	94·9	
7	Magh ...	$\frac{1}{10}$	Not analysed.						
8	B 208 ...	$\frac{1}{10}$	16·79	0·67	17·46	3·95	18·39	91·3	

TABLE II.

BLOCK D.—RATOON CANE, 1914-15 (VARIETIES).

(*Figures are per acre.*)

Plot.	Variety.	Plot area.	Cane.	Juice.	Juice on cane.	Total sugar in juice.	Total sugar in juice.	Cane sugar in juice.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre	lbs.	lbs.	Per cent.	Per cent.	lbs. per acre	lbs. per acre.	
1	B 147 ...	¼	61,782	37,324	60·40	17·95	6,700	6,524	
2	Striped Mauritius.	¼	68,096	40,110	58·90	15·40	6,177	5,764	
3	B 376 ...	¼	61,992	36,512	58·90	16·57	6,050	5,817	
4	B 147 ...	¼	67,214	40,572	60·37	17·94	7,279	7,096	
5	Striped Mauritius.	¼	63,140	37,394	59·22	16·72	6,253	5,980	
6	B 376 ...	¼	56,590	35,616	62·94	17·14	6,105	5,930	
7	Magh ...	1/10	25,708	14,450	56·20	...	...	...	
8	B 208 ...	1/10	48,660	29,540	60·70	17·46	5,158	4,960	

It will be seen from Table I that the juice of most of the varieties is of high quality, being rich in cane sugar and low in invert sugar and other solids, with desirably low glucose ratio and very high purity. Such juices are easy of defecation and eminently suited to central factory work.

The yields of ratoon cane this year were in considerable excess of last year's, and presumably for two chief reasons, *viz.*, that the area on which the ratoons were grown last year is amongst the worst on the farm, and secondly this year's ratoon cane received 30 maunds cake per acre as against 20 maunds last year.

The same three varieties that have consistently done best for years, *viz.*, B 147, B 376 and Striped Mauritius, still continue to hold the lead. Comparing the results of these three varieties for both the plant and ratoon crops of the present rotation, with those of the same varieties in the last rotation when they occupied the same piece of land (Block D), we find a considerable increase in sugar production as shown below :—

	Average production of total sugar per acre per annum.	
	1909-10 1910-11.	1913-14 1914-15.
1	2	3
	lbs.	lbs.
Striped Mauritius	6,450	6,893
B 147	4,720	7,265
B 376	4,450	6,460

Sugarcane Varieties. Plant Cane.

8. The area to come under plant cane this year in the rotation we have adopted was Block E. As mentioned in paragraph 16 of last year's report, a part of this block was dressed in 1913 with Flour Phosphate at the rate of 7 maunds per acre,

previous to green manuring with Cowpea. The planting scheme was as follows :—

B 376 ...	Two $\frac{1}{10}$ acre plots of each variety on the unphosphated area.
B 147 ...	
Striped Mauritius ...	
B 376 ...	Two $\frac{1}{10}$ acre plots of each variety on the phosphated area.
B 147 ...	
Striped Mauritius ...	
B 208 ...	$\frac{1}{10}$ acre plots.
Gandari ...	
Magh Sport...	
Kheri ...	
Red Tanna ...	

Block E was under plant cane in 1910-11, ratooned in 1911-12. It carried *aus* paddy and *matikalai* in 1912-13 without manure. In the spring of 1913 a plot measuring 0·7 acre was dressed with 7 maunds per acre Flour Phosphate. The whole block was green manured with Cowpeas during the rains 1913, followed by mustard in the cold weather of 1913-14. As the soil had by this time become acid again (it received 30 maunds Slaked Lime per acre in 1909), a dressing of 10 maunds ground Limestone per acre was applied in January 1914. Sugarcane was planted in the spring of 1914. The sets were transplanted from the Nursery in rows 4 feet apart at the rate of 8,000 per acre. Manuring was as follows :—

Plots 1 to 3 (non-phosphated area) ...	200 maunds cowdung per acre at planting.
Plots 1a to 3a (phosphated area) ...	150 maunds cowdung per acre at 1st earthing.
	150 maunds cowdung per acre at 2nd earthing.
Total	500 maunds.

Plots 4 to 6 (unphosphated area)	... 200 maunds cowdung per acre at planting.
	25 maunds cowdung 8¾ mds. cake at 1st earthing.
Plots 4a to 6a (phosphated area)	... 25 maunds cowdung 8¾ mds. cake at 2nd earthing.
Total ...	... 250 mds. cowdung and 17½ mds. cake.

Cowdung was valued at its current market price of 2¼ annas per maund, and cake at Rs. 2, the money value of 250 maunds cowdung being supplied as cake in plots 4 to 6 and 4a to 6a. Cultivation subsequent to planting was as usual, *viz.*, weeding, 1st and 2nd earthings, and stripping. Any diseased canes were removed periodically. The results appear in Tables III and IV.

TABLE III.

BLOCK E.—PLANT CANE, 1914-15 (Varieties).

Juice.

Plot.	Variety.	Plot area.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity Co-efficient.	Remarks.
1		Acre.	Per cent.	Per cent.	Per cent.		Per cent.		
1	B 376	$\frac{1}{10}$	17·66	0·26	17·92	1·47	18·84	93·7	The (*a*) plots were on the Phosphated area. Some of these plots were becoming a little overripe unfortunately before they could be harvested; the phosphate plots appear to have ripened off a little earlier than those on the unphosphated area, and to have become overripe more quickly.
1*a*	B 376	„	17·66	0·26	17·92	1·47	18·54	95·2	
4	B 376	„	16·71	0·31	17·02	1·85	18·0	92·8	
4*a*	B 376	„	15·05	0·53	15·58	3·52	16·1	93·4	
2	B 147	„	17·24	0·34	17·58	1·97	18·61	92·6	
2*a*	B 147	„	16·92	0·41	17·33	2·42	18·04	93·8	
5	B 147	„	17·48	0·35	17·83	2·00	18·69	93·5	
5*a*	B 147	„	16·82	0·45	17·27	2·67	17·84	94·3	
3	Striped Mauritius	„	16·95	0·32	17·27	1·89	18·1	93·6	
3*a*	Striped Mauritius	„	17·25	0·34	17·59	1·97	18·43	93·6	
6	Striped Mauritius	„	16·22	0·45	16·67	2·77	17·48	92·8	
6*a*	Striped Mauritius	„	15·73	0·59	16·32	3·75	16·97	92·7	

TABLE IV.

Block E.—Plant cane, 1914-15 (Varieties).

(Figures are per acre.)

Plot.	Variety.	Plot area.	Cane.	Juice.	Juice on cane.	Total sugar in juice.	Total sugar in juice.	Cane sugar in juice.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre.	Lbs.	Lbs.	Per cent.	Per cent.	Lbs.	Lbs.	
1	B 376	1/10	59,630	40,280	67·55	17·92	7,218	7,114	The (*a*) plots were on the phosphated area.
1*a*		,,	55,760	32,930	59·05	17·92	5,901	5,816	
4		,,	53,100	30,590	57·60	17·02	5,206	5,111	
4*a*		,,	47,580	27,150	57·06	15·58	4,230	4,086	
2	B 147	,,	50,300	30,000	59·63	17·58	5,273	5,171	
2*a*		,,	44,140	26,370	59·73	17·33	4,569	4,461	
5		,,	51,660	29,250	56·62	17·83	5,215	5,113	
5*a*		,,	52,000	29,700	57·10	17·27	5,128	4,995	
3	Striped Mauritius ...	,,	64,980	39,610	60·96	17·27	6,841	6,715	
3*a*		,,	58,150	33,360	57·37	17·59	5,868	5,755	
6		,,	53,920	30,880	57·27	16·67	5,148	5,009	
6*a*		,,	52,900	27,950*	52·83*	16·32	4,561	4,396	* These figures are too low, and cannot be accepted as accurate.
	B 208	,,	36,000	Not analysed. Weight of cane per acre only taken.					
	Gandari	,,	38,900						
	Mag—sport	,,	37,720						
	Kheri	,,	58,600						
	Tanna	,,	36,900						

The yields of cane and sugar per acre produced this year by the plant cane are lower on the average than those of the past few years; indeed they are very closely similar to the figures obtained on the same area when last under plant cane in 1910-11. The season was somewhat adverse, the rainfall being smaller than usual. During the months April to June, when the cane should be making vigorous growth, the actual rainfall was 10 inches below the normal. There was also practically no rain after the end of September, though we usually expect some 6 to 7 inches between that time and the cane harvest. Again, though the juices are, as usual, high in sucrose and of very high purity, owing to trouble with the oil engine and the mill rollers having worn somewhat hollow in the centre, the average percentage of juice extracted was nearly 8 per cent. lower this year than last. This reduces the sugar per acre very considerably. The engine and mill after 4 years' very satisfactory work now require overhauling.

With regard to differential manurial treatment, cowdung alone has this year given better results than cowdung *plus* oil cake, the average yields from the three varieties B 376, B 147 and Striped Mauritius being as follows :—

—	Cane per acre.	Sugar per acre.
1	2	3
	lbs.	lbs.
Cowdung plots	55,493	5,945
Half cowdung + oil cake...	51,860	4,915

This is a very much greater difference in favour of cowdung than was obtained last year. This is probably not unconnected with short rainfall. In regard to the effect of phosphate, a similar difference exists in favour of the non-phosphated area, the average yields for the same three varieties being as follows :—

	Cane per acre.	Sugar per acre.
	lbs.	lbs.
Non-phosphated area ...	55,588	5,817
Phosphated area ...	51,755	5,048

While this was unexpected, it is only fair to point out that the phosphated area carried in the preceding cold weather a very much heavier crop of mustard and that the soil here is shallower and poorer than that of the non-phosphated area. This experiment is being continued on all the cane areas, a part receiving phosphate in each case and further results must be awaited before we can pronounce any judgment on the value on this farm of phosphate for cane.

Sugarcane planting experiment. Ratoons.

9. This was sent out in Block D in 1913. There are 4 plots each $\frac{1}{10}$ acre in area. Two varieties of cane were experimented with. In one plot of either variety the rows were 4 feet apart and in the other 5 feet apart. The number of sets planted in each row was the same. Distance between rows, and hence number of sets per acre, were the only variants. The results for the plant cane crop appear on pages 16 and 19 of last year's report. Cultivation and manuring was the same as in the ratoon variety experiments. The results are given in Tables V and VI.

TABLE V.

Block D.—Ratoon cane, 1914-15.—*Planting experiment.*

	Width apart of rows.	Cane per acre.	Juice per acre.	Juice on cane.	Cane sugar in juice.	Invert sugar in juice.	Total sugar in juice.	Glucose ratio.	Total solids in juice.	Purity co-efficient.	Total sugar in juice per acre.	Sucrose in juice per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Feet.	lbs.	lbs.	Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	lbs.	lbs.	
B 376	4	62,140	39,148	63·0	17·44	0·49	17·93	2·82	18·53	94·6	7,019	6,827	
	5	62,420	37,845	60·63	18·31	0·29	18·60	1·60	19·14	95·6	7,040	6,930	
B 147	4	61,200	35,520	58·04	18·05	0·36	18·41	1·97	19·16	94·2	6,539	6,411	
	5	60,680	36,620	60·35	18·43	0·26	18·69	1·43	19·58	94·1	6,844	6,749	

TABLE VI.

Block D.—Ratoon cane, 1914-15.—*Planting experiment.*

Variety.	Plot area.	Number of rows.	Width apart of rows.	Number of sets per acre.	Number of canes per row.	Weight of cane per row.	Weight of cane per acre.	Remarks.
1	2	3	4	5	6	7	8	9
	Acres.		Feet.			lbs.	lbs.	
B 376 ...	$\frac{1}{10}$	10	4	5,400	167	621	62,140	Each row had same number of sets.
	$\frac{1}{10}$	8	5	4,320	200	780	62,420	
B 147 ...	$\frac{1}{10}$	10	4	5,400	173	612	61,200	Distance between rows and hence number of sets per acre were the only variants.
	$\frac{1}{10}$	8	5	4,320	218	759	60,080	

Judged by the weight of cane per acre or the weight of sugar in the juice, for either variety the results of the two plots are in remarkably close agreement.

Last year's ratoon experiment showed that the advantage lay with wider planting; while the present results show no such advantage, they clearly indicate that ratoons 5 feet apart between rows will crop equally as well as those only 4 feet apart, though this is not the case with the plant cane crop. For the two crops, plant and ratoon combined, planting 4 feet apart between the rows will give the bigger total yield, at any rate under our conditions of soil and manuring, and planting the sets 2 feet from centre to centre in the rows.

Sugarcane planting experiment! Plant cane.

10. This was commenced in Block F in 1914. It was set out to determine the optimum number of sets for 4 and 5 feet spacing of the rows, respectively. Results in previous years have indicated that on this farm at any rate 7,000 or 8,000 sets per acre is the maximum that can be planted, and further that good crops of cane could be expected from planting in rows 4 feet or even 5 feet apart, provided that the above number of sets per acre be used. In estate cane cultivation, where steam tackle is used, the almost universal practice seems to be to space the rows 5 feet apart, and sometimes even more, but 5 feet seems to be generally the most economical spacing.

One variety of cane only, B 147, was used this year. Cultivation was the same as for the variety experiments in Block E. Manuring for all plots was identical, *viz.*, 250 maunds cowdung and 17½ maunds cake per acre, 200 maunds cowdung being used in the rows at planting time, and 25 maunds cowdung and 8¾ maunds cake at first and second earthing respectively. As in actual estate work it would be impossible to actually count and plant any exact number of sets per acre, it was considered better to plant the sets according to certain definite methods, *i.e.*, allowing approximately so far apart in the row, or planting end to end, etc., and then to subsequently count the sets per plot actually used in any scheme.

The results appear in Tables VII and VIII. It is to be much regretted that owing to shortage of labour and very bad weather, these plots were all over-ripe at the commencement of harvesting and became more over-ripe fairly rapidly as harvesting continued. We do not therefore propose to lay any stress on the analytical figures for the composition of the juice. Judging the experiment by the criterion of cane per acre only, which is perhaps the fairest thing to do in this case, the only conclusion

permitted would seem to be that, under our conditions of soil and manuring, something of the order of 8,000 sets per acre is indicated as the most economical rate. This agrees with our previous work, and is being further tested during the current year.

TABLE VII.

Block F.—Plant cane, 1914-15.—*Planting experiment.*

Variety.	Plot No.	Method of planting.	Plot area.	Number of rows.	Width apart of rows.	Number of sets per acre.	Weight of cane per row.	Weight of cane per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10
			Acres.						
	1	Ordinary method ...	$\frac{1}{12}$	5	4	6,552	1,044	62,640	
	2	Sets end to end ...	$\frac{1}{12}$	5	4	8,196	1,122	67,344	
	3	Double row, ordinary ...	$\frac{1}{12}$	5	4	10,920	1,039	62,328	
	4	Double row, end to end...	$\frac{1}{12}$	5	4	21,456	1,135	68,112	
	5	Ordinary method ...	$\frac{1}{12}$	4	5	5,460	1,007	48 312	
	6	Sets end to end ...	$\frac{1}{12}$	4	5	7,332	1,199	57,540	
	7	Double row, ordinary ...	$\frac{1}{12}$	4	5	8,736	1,309	62,832	
	8	Double row, end to end...	$\frac{1}{12}$	4	5	16,164	1,140	54,720	

TABLE VIII.

Block F.—Plant cane, 1914-15.—*Planting experiment.*

Variety.	Plot No.	Method of planting.	Width apart of rows.	Sets per acre.	Weight cane per acre.	Weight juice per acre.	Juice on cane.	Cane sugar in juice.	Invert sugar in juice.	Total sugar in juice.	Glucose ratio.	Total solids in juice.	Purity co-efficient.	Total sugar in juice per acre.	Sucrose in juice per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
			Ft.		lbs.	lbs.	Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	lbs.	lbs.	
	1	Ordinary method ...	4	6,552	62,640	37,860	60·44	15·96	0·47	16·43	2·95	17·53	91·0	6,220	6,043	The cane was over-ripe at harvest.
	2	Sets end to end ...	4	8,196	67,344	40,540	60·2	15·31	0·57	15·88	3·74	16·98	90·1	6,438	6,207	Owing to bad weather a fortnight elapsed between crushing the earlier plots and the last plots of this series, which became progressively more over-ripe, this probably accounting for the lower quality of the latter.
	3	Double row, ordinary	4	10,920	62,328	37,940	60·87	15·22	0·52	15·74	3·39	16·8	90·6	5,972	5,774	
	4	Double row, end to end	4	21,456	68,112	41,535	60·98	15·02	0·55	15·57	3·66	16·78	89·5	6,467	6,239	
	5	Ordinary method ...	5	5,460	48,312	29,165	60·37	14·64	0·65	15·29	4·40	16·22	90·2	4,460	4,270	The analytical figures are not a reliable index for above reasons.
	6	Sets end to end ...	5	7,332	57,540	34,248	59·52	14·96	0·58	15·54	3·87	16·6	90·1	5,322	5,124	
	7	Double row, ordinary	5	8,736	62,832	37,135	59·1	14·08	0·72	14·80	5·10	16·23	86·7	5,496	5,229	
	8	Double row, end to end	5	16,164	54,720	32,175	58·8	14·49	0·74	15·23	5·09	16·53	87·6	4,900	4,663	

New varieties of cane.

During the year under report three new varieties of cane were received from Barbadoes, of which two show exceptional promise. Six more have since been sent us by Dr. Barber, the Imperial Sugar Expert, and are being grown this year.

Soil Investigations.

11. This work described more or less fully in the last three annual reports* of this farm was continued. It was commenced in 1909 and comprises the following experiments : —

Block G.—Liming experiment laid down in 1909.

„ C.—Liming and manurial experiment; also wood ashes experiment commenced 1911.

„ K.—Experiment to ascertain the reasons underlying the remarkable effect of lime, laid down 1912.

„ L.—Ground limestone experiment, started 1913.

„ E. & B.—Experiments in the use of Flour Phosphate commenced 1913 and 1914, respectively.

Block G. Liming experiment.

12. This block, half of which was limed 6 years ago with 50 maunds slaked lime per acre, was green manured with cowpeas in the rains of 1914; as usual this crop grew much stronger on the limed side. Cowpeas were dug in during August, and the usual crops *matikalai*, oats, gram and mustard were sown as cold weather crops. Germination was fair all over the area, but the seedlings early died out on the unlimed side. All the crops on the limed side matured very small crops. These limed plots are producing gradually less and less outturn every cold weather. Acid conditions have been steadily re-establishing themselves from below upwards since the lime was applied, and though the soil is not as yet definitely toxic again, inasmuch as it is at present carrying a crop of Jowar, which crop absolutely refuses to grow in toxic soil, still the gradually increasing acidity is progressively limiting crop production, and it seems to be only a matter of time until the soil will again refuse to mature any cropping at all. It is our intention to observe after how many years this will occur. The whole block was green manured in 1912 with a catch crop of cowpeas, also with 100 maunds cowdung in the autumn of 1913, and was again green manured with cowpeas in 1914. This gradual limitation of crop production on the limed side is therefore apparently not seriously connected with any lack of plant food, and can only be put down to the gradual re-establishment of acid conditions. This has affected some crops more than others; oats seem to suffer less year by year than gram

* Annual reports of the Jorhat Experiment Station for the years ending June 30th 1912, 1913 and 1914.

does for instance. Indeed gram only made what might be called a crop the same year that the lime was applied. It is a crop which requires a lot of lime to do well. These gradually accumulating results only emphasize what we have observed in other experiments, *viz.*, that some crops respond better to heavier dressings of lime than others, and demand more of it. In studying the question of liming, then, the nature of the crops to be grown demands consideration, and this in itself is not an unimportant conclusion to have reached.

Block C. Liming and manurial experiment.

13. This experiment commenced in 1911 was continued in its 4th year, according to the scheme of manuring and rotation laid down.

The plots, which had ten maunds lime per acre in 1911, 1912 and 1913, were given a fourth dressing of 10 maunds per acre in the year under report, and the bonemeal and cowdung dressings were applied to their respective plots as before. The two plots, which had 30 maunds lime per acre in 1911, were given 30 maunds additional lime per acre this year. The 60 maunds lime plots remain as they were.

The cropping during 1914-15 was:—

	Non-green-manured block.	Green-manured block.
Rains	Jowar for fodder.	Jowar for fodder.
Cold weather	Matikalai	Matikalai.

Observations during growth.

The Jowar germinated as usual all over the area, the seedlings dying off quite early on the unlimed plots. This year as the limed areas more nearly approached equality in regard to the amount of lime added, the superiority of the jowar on the more heavily limed areas, which was so very apparent to the eye in 1912-13 when the plots were last under the same crop, was not so strongly marked. Still it was clearly observable. One particularly striking feature of the jowar this year was the peculiar action of bonemeal, especially marked on the ungreen-manured block. There it was clearly apparent that the bonemeal was for some reason deleterious to the crop. In the absence of cowdung this was to a less extent observable on the green-manured block also. This action of bonemeal was also noticed in 1912-13 on the Jowar crop. Its bearing will be discussed later.

Matikalai, sown as the rabi crop on October 8th, rather late for this crop, all germinated well. The crop carried through, all over both blocks, but as with all other crops looked best on the

more heavily limed areas especially where it received the cross dressings in addition. The crop showed a patchy appearance even within the limits of individual sub-plots, which has been noticed before with other crops, and especially with jowar. The toxicity of this soil appears to vary sharply from place to place within small areas, though it might be supposed that cultivation for a few years would level matters up. It does not appear to do so however. The same has been noticed all over the Farm from year to year with a variety of cropping. The fact is clearly apparent though as yet no reason can be assigned.

The green-manured block was throughout ahead of the other. The results are given in Table IX.

TABLE IX.

Block C.

Jowar and Matikalai—Fourth year of Experiment.

Cross dressings.	Non-green-manured block.				Green-manured block.			
	No lime.	Lime 40 mds. (10+10+10+10).	Lime 60 mds. (30+30).	Lime 60 mds.	No lime.	Lime 40 mds. (10+10+10+10).	Lime 60 mds. (30+30).	Lime 60 mds.
1	2	3	4	5	6	7	8	9
	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.
Nil	J. 0 0	J. 53 30	J. 92 0	J. 83 0	J. 0 0	J. 112 20	J. 65 0	J. 104 0
	M. 0 2½	M. 0 22⅓	M. 0 15	M. 1 0	M. 0 2½	M. 2 0	M. 1 35	M. 0 27½
Bonemeal 3 mds. per acre in 1st, 2nd, 3rd and 4th years.	J. 0 0	J. 16 0	J. 25 0	J. 33 0	J. 0 0	J. 79 0	J. 46 0	J. 120 0
	M. 0 7½	M. 0 5	M. 0 15	M. 1 0	M. 0 20	M. 2 5	M. 2 2½	M. 1 0
Bonemeal 3 mds. and cowdung 100 mds. per acre in 1st, 2nd, 3rd and 4th years.	J. 0 0	J. 70 20	J. 106 0	J. 92 0	J. 0 0	J. 112 0	J. 159 0	J. 149 0
	M. 1 35	M. 1 0	M. 0 22⅓	M. 1 15	M. 0 25	M. 2 20	M. 2 15	M. 2 10
Cowdung 100 mds. per acre in 1st, 2nd, 3rd and 4th years.	J. 0 0	J. 90 30	J. 160 20	J. 182 20	J. 0 0	J. 105 20	J. 142 0	J. 160 0
	M. 1 0	M. 2 35	M. 1 20	M. 2 35	M. 1 10	M. 3 5	M. 3 20	4 20

All figures are per acre.

J.—Green Jowar.

M.—Matikalai Grain.

1 md.=82 lbs.

After the marked beneficial action of lime, so clearly shown in the Table, perhaps the most outstanding feature of this year's results is the great superiority of the green-manured block in general. Thus the total yield of the two crops for the green-manured block as against the non-green-manured block may be expressed by the following ratios :—

Jowar 1·35 to 1.
Matikalai 1·82 to 1.

To further emphasize the value of organic matter the following figures expressed as ratios are instructive :—

	Yield of crop from cowdung plots. / Yield of crop from non-cowdung plots.	
	Jowar.	Matikalai.
For whole area	1·84 to 1	2·37 to 1.
For non-green-manured block separately	2·32 to 1	3·55 to 1.
For green-manured block separately	1·57 to 1	1·95 to 1.

As one would expect, the ratio for the non-green manured block is greater than that for the green-manured one, in both cases. Undoubtedly one of the greatest demands of these old alluvial soils of the Assam Valley is far in abundance of organic matter. This cannot be too strongly insisted upon; other manures, in its absence, cannot possibly exert their maximum of effect. The differences in crop yield as between the variously limed strips are becoming less marked as the experiment matures, as the plots which receive recurring small doses of lime gradually approach in total amount to that used on those plots which received larger initial dressings. This is as was to be expected, and as the experiment matures valuable evidence should be forthcoming in regard to the question of large initial *versus* smaller recurring doses of lime.

As remarked earlier, the use of bonemeal exercised a deleterious effect on the jowar crop, when used in the absence of any organic manure at all, being less pronounced when cowdung was used as well, still less marked when used with green manures alone, and becoming a positively beneficial effect when used along with both cowdung and green manures. The same effect has been noticed to a less extent on other crops in the rotation, and is evident in some cases in the *Matikalai* crop of the present year. But when jowar is the crop grown, this action of bonemeal is particularly conspicuous. Analysis of this year's

jowar yields shows that on the non-green-manured block the lime+bonemeal plots only produced some 32 per cent. of the crop that the lime plots alone did, while on the green-manured block the outturn was raised to 87 per cent. of that of the lime alone plots. A consideration of the plots cross dressed with cowdung+ bonemeal in the one case, and cowdung alone in the other, shows that for the non-green-manured block the cowdung +bonemeal plots yielded only 62 per cent. of the crop given by the plots receiving cowdung only, this figure being raised to 103 per cent. in the case of the green-manured area. These figures very strongly emphasize the enormously beneficial role that organic manures play in the economy of plant production on these old soils. At first we were inclined to attribute this behaviour of bonemeal to its very great stimulative action on weed production, which has been well marked for years on this soil wherever any form of phosphate is used.

That this enhanced growth of weeds on the bonemeal plots does introduce an adverse element of competition, particularly marked in the rains when the weed problem is a very difficult one to deal with, admits of no doubt ; we have ample experimental evidence of it from other areas. On the other hand, that the reduction in crop production by the use of bonemeal is entirely to be explained by the extra element of competition introduced, does admit of doubt, because no such reduction follows on the use of cowdung alone for instance, which also favours enhanced weed production, and further it has also been observed in the cold season cropping, at a time when weeds are a much less serious consideration. There is another possible solution of this matter, and it is being worked out on plots specially laid down for this purpose.

Block C. Wood ashes experiment.

14. Commenced in 1911. This experiment was designed to prove to cultivators that wood ashes conserved and regularly used could replace lime as a soil ameliorant, and would render cold-weather crop production possible. There are five plots receiving per annum respectively 5, 10, nil, 15, and 20 maunds wood ashes per acre. Half of each plot is cross dressed with cowdung at the rate of 100 maunds per annum. In this the fourth year of the experiment, cowpeas were grown as green-manure in the rains on all plots, followed by oats in the cold weather. In view of the green manuring, no cowdung was applied for the oats crop this year. The cowpeas were dug in the middle of August and oats sown on October 11th. The seed oats were poor, and germination was likewise. The seedlings early died out on the plots receiving no ashes and also on that annually getting 5 maunds ashes in absence of cowdung. All the other plots matured crops, small in most cases but increasing with the amount of ashes applied. On accoun

of bad weather harvesting was unduly delayed, and continued wet weather prevented the crops being dried out for weighment before they went rotten. No figures are available in consequence and though the crop in common with oats crops all over the farm this year was poorer than in the previous cold weather by reason of the absence of rain after sowing and throughout the growing period, still the experiment teaches what it was designed to do, namely, that it will pay cultivators to conserve their ashes and apply them if they wish to grow rabi crops.

Block L. Ground limestone experiment.

15. This experiment was started in 1913 on ground newly broken up. The soil is very poor and unfertile. The scheme consists of 6 plots of $\frac{1}{3}$ acre each in two series of 3 plots each. One series, Section A, is always cultivated shallow with country implements, the other Section B is cultivated more deeply with English implements. Ground limestone was applied as follows in 1913 :—

Sections A and B { ... Plot 1, 15 maunds limestone per acre.
... „ 2, nil.
... „ 3, 30 maunds limestone per acre.

The cropping, as for the first year, was cowpeas for green manure in the rains, followed by oats in the cold weather. The cowpeas grew well and were dug in towards the end of August. Oats were sown in all plots on October 10th ; germination was fairly good, occurring earlier on the limed plots. The seedlings as usual died out on the unlimed plots entirely.

The limestone plots all matured their crop, which was harvested, threshed and weighed, the results appearing in Table X :—

TABLE X.

OATS.

Figures are per acre.

Plot.	Treatment	Section A.		Section B.		Remarks
		Grain.	Straw.	Grain.	Straw.	
1	2	3	4	5	6	7
		lbs.	lbs.	lbs.	lbs.	
1	18 maunds limestone ...	105	371	93	339	Section A is cultivated shallow, 3 to 4 inches deep with country implements.
2	Nil	Nil.	Nil.	Nil.	Nil.	Section B is cultivated deeper.
3	30 maunds limestone ...	302	705	240	810	Six to 8 inches deep with English implements.

Throughout the growing period the oats appeared greener and more healthy on the shallow cultivated section, and the results confirm this observation. In keeping with all other oats on various parts of the farm the crops this year are poor, and smaller than last year. The seed was of poor quality, and practically no rain fell after sowing throughout the growing period. However, the results confirm last year's observations in regard to the value of ground limestone as an ameliorant for sour soils. For light or loamy soils it is undoubtedly preferable on many grounds to caustic or slaked lime. To the uninitiated the results this year might seem to indicate that shallow cultivation is better than deep. Such a deduction is quite illegitimate in the case of a comparatively shallow rooting crop like oats in this scheme. To obtain a correct view the results must be considered in relation to the lime distribution within the soil. Section B has been cultivated twice as deeply as Section A. As a result, the limestone used in the former section has been mixed with roughly twice as much soil as it has been in the latter. Therefore the acidity in the cultivated soil of Section A has been more completely neutralised than it has been in Section B. To put it another way with any given dressing of limestone per acre, twice as much limestone has been incorporated with the first 3 to 4 inches of soil in Section A, as has been incorporated to the same depth in the corresponding plot of Section B. The following statement will clear up this point :—

In Section A, shallow cultivation, 15 and 30 maunds limestone per acre, represent respectively an addition of 50 per cent. and 100 per cent. of the soils requirements for lime to cultivation depth, *viz.*, 3 to 4 inches. In Section B, deep cultivation, 15 and 30 maunds limestone per acre represent respectively an addition of only 25 per cent. and 50 per cent. of the soils requirement for lime to cultivation depth, *viz.*, 6 to 8 inches. Looking at the results then in this way they simply mean that the oats have done better on those plots (Section A) whose acidity has been the more completely neutralised to a depth of 3 to 4 inches than they did on the corresponding plots (Section B) where acidity was less completely neutralised but to a greater depth. The results of this experiment may be expected to vary from year to year with the nature of the crop grown, *i.e.*, whether shallow or deep rooting, and again whether more or less tolerant of soil acidity. The results at any rate demonstrate that in considering how much lime per acre to apply, regard must be had to the depth to which it is desirable to incorporate it bearing in view the nature of the cropping.

To form some estimate as to the effect of deep cultivation on the crop of oats under discussion, we must compare plot 1, Section A, with plot 3, Section B ; in both these plots the soil to cultivation depth has had some 50 per cent. of its total lime requirements satisfied ; plot 3 B gave more than twice the crop that plot 1 A did, and this must be attributed, partly at any rate, to the deeper cultivation.

Blocks E and B. Flour Phosphate experiments.

16. Part of both these blocks, which regularly come under our sugarcane rotation, has been dressed with flour phosphate with a view to observing its effect on the various crops of the rotation, which is as follows :—

1st year	...	Plant cane, manured.
2nd „ ...	...	Ratoon cane, manured.
3rd „ ...	...	*Aus* paddy or Maize without manure in the rains.
		Matikalai without manure in the cold weather.
4th „ ...	...	Cowpeas for green manure in the rains.
		Fallow or mustard without manure in the cold weather.

The flour phosphate was applied before the green crop of cowpeas in the 4th and last year of the rotation in each case. The succeeding cowpeas clearly benefit from the phosphate, and by their rapid decomposition after ploughing in assist in rendering it available for the following crops.

Block B comprises 3 acres ; of this, one acre was dressed with 7 maunds flour phosphate in April 1914 ; the other two acres were not phosphated. Mustard was sown over the whole area in the cold weather 1914-15.

The following was the result :—

Yield from one acre phosphate area 820lbs. grain.

Yield per acre non-phosphate area 164lbs. grain.

The phosphate gave an increase of 656lbs. mustard grain per acre, whose value is at least double that of phosphate applied. Its effect on succeeding crops in the rotation will be noted.

Extension area.

17. The western half of Block M and the whole of the Block O received ground limestone at 30 maunds per acre in May 1914. The whole of block M was sown with Sann hemp for a green crop in the rains ; it germinated well all over, but made no growth at all on the unlimed side. On the limed side it made good growth and was ploughed in during August when some 3 to 4 feet high. Dhain-

cha was sown as green-manure on Block O (30 maunds limestone per acre), and on Block R (no limestone) for comparison. In this case the unlimed land produced a fair crop, but it was distinctly better on the limed block. Apparently Dhaincha, like cowpeas, will make quite fair growth on this land without any lime, but sann hemp quite refuses to grow in its absence.

Other crops.

18. Block A was under maize followed by *matikalai*. The maize was sown too late, but made very good growth indeed. As the land had to be prepared for *matikalai*, the maize had not time to ripen its cobs, and was cut green for feeding to the cattle early in September. The *matikalai* sowing was somewhat late in consequence, and the ensuing crop was poor. Block H was put down during the rains with successive sowing of cowpeas for seed, but they were destroyed by insect pests just before flowering, as usual, and had to be burnt off. If left for seed purposes, destruction by pests in the early autumn appears to be the general fate of cowpeas sown here in the rains, though in no case have we ever failed to succeed in growing most excellent green-manure crops of cowpeas during this period. It is far and away the best green-manure crop we have. A late sowing made early in September did somewhat better and matured some seed, yielding however only a poor crop of 2 maunds 22½ seers per acre. This year a series of successive sowings is again being made, with a view to finding the most suitable season for growing cowpeas for seed.

The following crops were grown in small plots in the kitchen garden for observation as to growth and seed purposes:—Cowpeas (varieties); Soybeans (varieties); winter vetch; Melilotus alba; Melilotus Indica; Java Natal Indigo; Velvet Beans; Sword Beans; ground nuts (varieties), Teff grass from South Africa; and Cotton (Buri and Combodia). The American varieties of cowpeas failed, but five Madras varieties did well, and seed was obtained for future sowings. Soybeans, four American varieties, for comparison with the Shillong and Jorhat farm varieties, were sown. The Jorhat and Shillong and one of the American varieties, Mongol, grew well; the other foreign seed produced only poor crops by comparison. Winter vetch, Melilotus alba and Indica failed to germinate. Java Natal Indigo germinated thinly, but grew rapidly and well to about 8 feet high, flowered and seeded well. Velvet and Sword Beans made excellent growth as usual; the former finally trailed to such an extent that it smothered the Sword Beans on the adjacent plot. The Velvet Bean is a very free and strong growing legume, and might form a very useful green-manure crop under certain conditions, but its extraordinary growth and trail-

ling habit make it dangerous to grow in the vicinity of other crops. Ground-nuts, six varieties, some received from Bombay, and the Central Provinces, were sown. All did well and ripened off seed, but the rats found them as usual, and little seed was saved.

Cotton, Buri and Combodia did better than last year, both varieties forming healthy bolls, but rather few in number. The comparatively dry year probably accounts for its healthier and better growth this year.

Fruit.

19. The fruit trees planted in the Orchard comprise 16 Lichis, 3 Langra Mangoes, 3 Fazli and 2 Raspura mangoes, 1 Custard apple, 3 Sopota, 5 Guavas, 1 Pomelo and 1 Plum. In addition some 280 Ceylon and 15 Spanish Pineapples are planted.

The Lichis are Muzafferpur, from 3 to 7 years old, and all bore much fruit of excellent quality, which was sold locally.

The Ceylon pines do very well, bearing large numbers of very large pine apples, very juicy and sweet, but lacking in distinctive flavour. The Spanish pines have not yet borne any fruit. The Langra mangoes flowered, but bore no fruit. Some few custard apples were obtained and for the first time the Sopota trees fruited, yielding a very sweet fruit not unlike a potato in external appearance. The guavas all bore much fruit; the trees originally came from Saharanpur; the fruits are big and fleshy, but not so sweet as the local variety. The Pomelo is now fruiting, while the plum trees fruited well this year.

Receipt and Expenditure.

20. The receipts amounted to Rs. 1,526 *plus* Rs. 140 (being the value of cane sets supplied for demonstration purpose) equal to Rs. 1,666 total. The total expenditure, including cost of establishment and charges on capital account, amounted to Rs. 12,393.

Establishment.

21. This consists of a Farm Superintendent on Rs. 100—10—200, a Fieldman clerk on Rs. 25—1-8—40 and a peon on Rs. 8. During the year Government sanction was obtained for two more apprentices but they were not appointed before the 30th June.

Two apprentices Bhudhar Phukan and Bholanath Gogai completed their training and were appointed temporary Demonstrators from 1st September 1914, and two new apprentices were appointed from 1st November, *viz.*, Biswanath Dutta and Chandi Charan Dutta, while Anandi Ram Gohain and Devendra Nath Hazarika continued their apprenticeship throughout the year.

Srijut Binaram Das held the post of Farm Superintendent and continued to do good work throughout the year. He was on privilege leave for 3 months from September 8th to December 7th, 1914, during which time Srijut Nabin Chandra Barua, Demonstrator, managed the Farm under the supervision of the Agricultural Supervisor, Assam Valley.

Srijut Mohi Chandra Gogai was appointed Fieldman clerk on the 22nd July 1914, and held the post up to 8th June 1915, when he left to join the Bihar Agricultural College as a Government Scholar. In his place Munshi Mohsin Ali was appointed on probation for one year from 15th June.

Inspection.

22. The Director of Land Records and Agriculture inspected the Farm twice. The Deputy Director Mr. Birt visited Jorhat 10 times and inspected the Farm several times on each occasion.

The following gentlemen visited the Farm during the year :—

The Officiating Chief Commissioner, the Hon'ble Lieutenant-Colonel P. R. T. Gurdon, C.S.I.

Mr. Henderson, Deputy Director of Agriculture, Sindh.

Khan Bahadur Maulvi Muhibuddin Ahmad.

Dr. C. A. Barber, Imperial Sugarcane Expert, Coimbatore.

Mr. Jackson, Superintendent, Gotonga Tea Company, Ltd.

Maulvi Faizuddin Ahmed, Extra Assistant Commissioner.

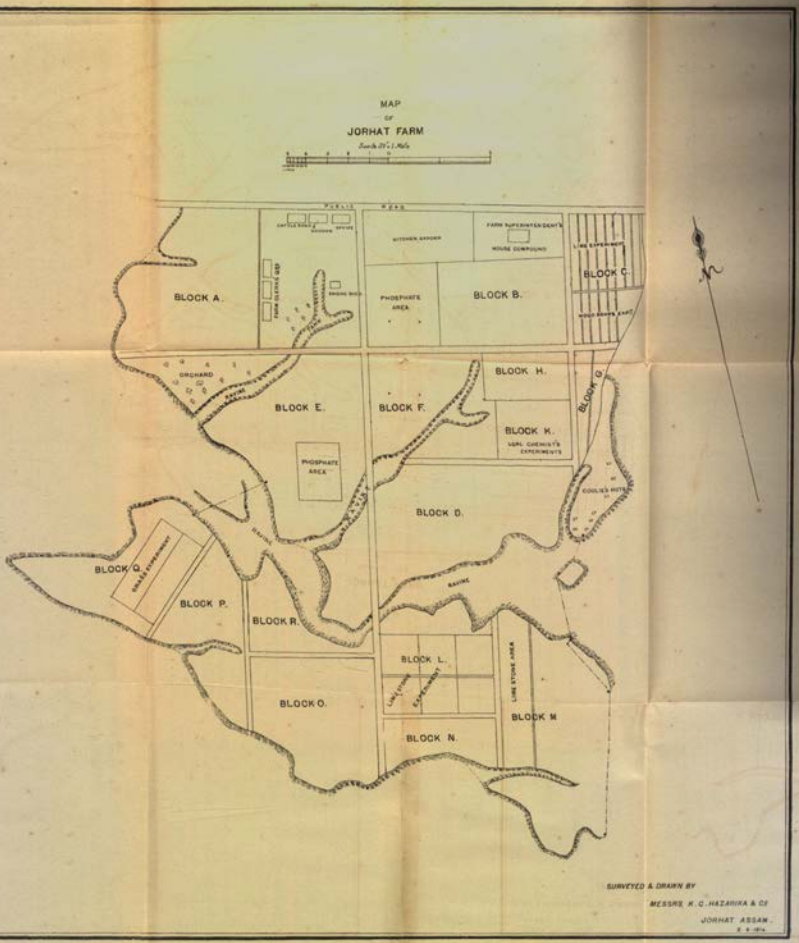
Messrs. Dr. Hope, Andrews, Cooper and Tunstall, Indian Tea Association, Scientific Staff, Tocklai.

Mr. L. A. Chapman, Scientific Officer, Jokai Tea Company, Ltd.

A. A. MEGGITT,

SHILLONG :
The 27th July 1915.

Acting Deputy Director of Agriculture, Assam.



D.O. Sanction No. 1883 of 1915

ANNUAL REPORT OF THE UPPER SHILLONG AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1915.

History and description.

The Upper Shillong Agricultural Station was established in 1897-98. It is situated on the Cherrapunjee road, 5½ miles from the town of Shillong, and occupies the site of the old Model Farm which ceased to exist in 1879. The elevation of the place is 5,900 feet, *i.e.*, about 900 feet higher than Shillong town. The total area of the farm is 366 67 acres; of which a large proportion is occupied by pine forest. Most of the cultivated and culturable land lies in a long narrow valley. The bottom of the valley was till recently a soft impassable morass which has been converted into firm pasture ground by deepening the stream which drains the valley and cutting lateral *nullahs* to connect with it. The herbage also has considerably improved thereby.

The soil of the higher lands is a coarse reddish loam of very loose texture which can be worked with the greatest ease. The subsoil is of a more pronounced reddish colour and of great depth. In a small portion of the cultivated area the soil is black owing, it is believed, to the existence of some mineral compound. At the bottom of the valley, a different type of soil is found, namely, clay or clayey loam, extremely rich in organic matter. Having long been under a thick growth of grass, the upper portion of this soil is a matted mass of half-decayed grass-roots.

In point of quality the soil of the farm is extremely poor, and very little can be grown on it without the help of manure.

The greater portion of the station suffers from the disadvantages of an exposed situation. The place is colder and more windy than Shillong; frosts are of very common occurrence and are more severe than in the town. During the winter, the growth of vegetation is entirely suspended.

Purposes of the *station.*

2. The main objects for which the station is maintained are the trial and introduction of new varieties of potatoes which are the most important among the crops grown on the plateau of the Khasi Hills, the breeding of improved strains of milch

cattle suitable for this tract and the cultivation of fodder. Fodder experiments have been tried from time to time, but having proved abortive, they have one after another dropped out of the programme of the farm. Very little experimental work beyond the potato trials is done at present on the farm, and if we leave out the cattle and the fodder crops grown for them, the station may be looked upon more as a seed-growing farm than one devoted to experimental work.

3. The following table gives the rainfall during the official agricultural year under report :—

Weather.

Rainfall.

	Actual, 1914-15.	Normal.	Number of rainy days, 1914-15.
1	2	3	4
	Inches.	Inches.	
1914.			
July	11·30	17·75	18
August	12·80	15·67	19
September	7·75	11·06	16
October	1·95	7·55	3
November	0·23	1·27	1
December	0·17	0·18	1
Total for 6 months ...	34·20	53·48	58
1915.			
January	0·57	0·29	2
February	2·40	1·02	5
March	2·18	2·25	6
April	5·20	4·48	5
May	22·59	8·83	26
June	15·11	20·04	18
Total for 6 months ...	48·05	36·91	62
Total for year	82·25	90·39	120

These twelve months really cover parts of two different agricultural seasons. This is particularly the case on the plateau of the higher Khasi Hills where the cropping season may be described as commencing in February and ending in November.

The short rainfall of September and October proved favourable to hay-making and did not affect other crops one way or the other.

The spring of 1915 proved disastrously wet. The rain began about the end of April and continued with slight interruptions well on into June. Last May has perhaps been the wettest May on record, the rainfall having amounted to nearly three times the normal, and it having rained 26 days out of the 31. The excessive dampness of the atmosphere brought on an early and severe attack of blight in the potato crop which was killed out weeks before it was due to mature. This happened all over the district. The sowing of the fodder crops was greatly hampered on account of continuous rain, and much of what was sown has remained stunted and will yield a poor outturn.

Summary of work.

4. The work done during the year included :—

(1) Trials of different varieties of potatoes.

(2) Growing potatoes for seed.

(3) A manure experiment in peaty soil.

(4) An experiment in warping of rice land.

(5) Trials of new crops.

(6) Fodder crops.

(7) Cattle-breeding.

(8) Sheep-breeding.

(9) Distribution of seeds, implements, etc.

Trial of varieties of potatoes.

5. Out of the 18 varieties of potatoes tried in the previous year (1914) 5 (namely, Gladiator, Harbinger, Belle-de-Juliet, White City and Californian) were discarded on the grounds of their being unproductive and liable to excessive disease, and the remaining 13 varieties were compared again in the season just closed (1915). Each variety was planted in duplicate plots, each $\frac{1}{40}$th of an acre. All the varieties were planted in March and harvested in August. Winter seed was used in each case. The land was given a dressing of 300 maunds of cowdung and 10 maunds of rapecake per acre. The crop was sprayed with 240 gallons of Bordeaux mixture per acre applied in two equal doses, but owing to heavy and incessant rain, much of the mixture got washed off the plants and was unable in consequence to exert its full effect.

The outturns of each variety in 1915 and in previous years are exhibited in the following table:—

Statement showing the average yield per acre on duplicate plots for the last eight years.

Variety.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	Average of last four years.	Average of last eight years.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	
1. King of Potatoes	172 20	217 35	186 20	234 0	201 0	131 20	95 30	319 0	202 29	194 31	
2. Magnum Bonum (1908)... ...	184 20	214 0	165 20	232 0	160 35	132 20	87 30	277 0	199 0	181 31	
3. King Edward VII	125 25	168 5	133 20	128 20	163 13	78 20	90 15	269 0	138 38	144 25	
4. Khasi Nainital	148 0	189 0	174 10	166 30	157 30	119 0	111 30	292 0	169 18	169 31	
5. Khasi Round	135 30	123 8	123 0	111 20	135 2	95 25	102 25	255 0	123 15	135 9	
6. Windsor Castle (1909)	164 0	209 35	158 20	205 0	181 15	63 15	...	...	184 14	...	
7. British Queen (,,)	200 30	196 5	152 30	181 20	189 35	92 30	...	...	182 31	...	
8. Up-to-date	166 30	207 25	186 20	178 0	153 0	90 0	...	...	184 29	...	
9. Magnum Bonum (1912) ...	134 20	170 10	156 0	224 0	...	...	...	...	171 8	...	
10. Windsor Castle (,,) ...	169 0	238 20	129 0	196 0	...	...	...	...	183 5	...	
11. British Queen (,,) ...	168 30	181 20	142 10	72 20	...	...	...	...	141 10	...	
12. Flour Ball	134 30	142 10	160 30	179 0	...	...	...	...	152 28	...	
13. Imperator	186 20	183 15	167 20	211 0	...	...	...	...	187 4	...	

A strict comparison of the yields of this year is not possible on account of the fact that the varieties being sprayed with Bordeaux mixture on different days must have been unequally affected according to the length of time which elapsed between the spraying and the next heavy shower which washed off the mixture. Similar inequalities no doubt happened in previous years, though to a much less extent than in the season under report.

Taking, however, the figures as they stand, it will be seen that King of Potatoes and Magnum Bonum of 1908 which headed the list in most of the previous years have been surpassed this year by British Queen of 1909. On the average of the past four as well as of the past eight years, King of Potatoes and Magnum Bonum of 1908 still occupy the first and second places, respectively. We have been growing these two varieties for some years past for purpose of distributing their seed in the Khasi Hills and in the province generally.

Excessive rain caused the potato disease to appear earlier and in a more aggravated form this year than usual. All the varieties fell a prey to it sooner or later. Khasi Round was killed out earliest of all, and Windsor Castle of both 1908 and 1912 and Flour Ball stood out longest.

As in former years, 50 tubers of each variety were selected at random, cut open and examined for signs of disease. The following table gives the results of the examination in the last seven years.

Varieties.	Number of diseased tubers out of 50 examined.						
	1909.	1910.	1911.	1912.	1913.	1914.	1915.
1	2	3	4	5	6	7	8
King of Potatoes *	10	12	Nil	Nil	Nil	1	5
Magnum Bonum (1908)	...	6	4	2	4	2	Nil
King Edward VII (1906)	Nil	18	8	4	6	5	4
Khasi Nainital (1908)	10	48	16	8	4	4	8
Khasi Round (1900)	Nil	4	8	6	10	6	6

*Figures for 1909-11 are for the old stock of King of Potatoes imported in 1906, while those for 1912-15 are for the new stock which was imported in 1912.

Varieties.	Number of diseased tubers out of 50 examined.						
	1909.	1910.	1911.	1912.	1913.	1914.	1915.
1	2	3	4	5	6	7	8
Windsor Castle (1909)	...	...	...	4	3	3	12
British Queen (1909)	Nil	12	Nil	6	4	2	8
Up-to-date (1909)	...	4	32	16	4	1	6
Magnum Bonum (1912)	...	...	...	6	6	2	2
Windsor Castle (1912)	...	...	...	4	3	2	10
British Queen (1912)	...	...	...	4	4	3	6
Flour Ball (1912)	...	...	...	6	3	1	10
Imperator (1912)	...	...	...	22	3	3	4

The proportion of diseased tubers was larger this year than in 1914, though compared with some of the previous years it was decidedly less. There is reason to believe that the use of Bordeaux mixture year after year on the farm and the practice of growing the crop on ridges instead of flat beds which is the rule with the Khasi cultivators have both tended to reduce the extent of disease in our potato stocks.

Twenty-eight pounds of seed of each of nine varieties of English potatoes was imported during the year from Messrs. Sutton & Sons of Reading. The seed was planted in March and the crop was harvested in July. Some of the varieties germinated badly, and none of them gave a satisfactory yield. The produce has been saved for planting in the autumn. The nine varieties include new importations of three varieties which we already possess, namely, Windsor Castle, Magnum Bonum and Up-to-date, and six varieties, which are new to the farm, namely, Starling Castle, Acquisition, Epicure, Edinburgh Castle, Balmoral Castle and Dover Castle.

Mention was made in the last year's report of seven new types of potatoes bred on the farm from seed. These were grown again last summer (1915) with a view to multiplication of seed. It is hoped there will be enough seed of these types next spring for making a comparative trial between them and the best varieties on the farm. Till then, nothing can be said about their respective merits. The area planted with each type last season was just

$\frac{1}{320}$th of an acre, except in the case of type No. 5, which occupied twice that area. The produce, calculated to the acre, varied from 68 maunds to as much as 220 maunds.

Potatoes for seed.

6. Four varieties of potatoes were grown during the year for the purpose of seed, namely, King of Potatoes, Magnum Bonum, Up-to-date and Windsor Castle. The crop was planted between the 22nd February and the 14th of March. The total area planted was 8·975 acres against 9·75 acres in 1914. The manures used were, as in previous years, 150 maunds of cowdung and 10 maunds of rape-cake per acre. The crop was sprayed as usual with Bordeaux mixture twice at the rate of 120 gallons each time, but like the experimental crop, it was seriously affected by an early outbreak of disease, which considerably reduced the yield. The outturn was as follows :—

Variety.	Area in acres.	Yield.
1	2	3
		Mds. srs.
King of Potatoes	3·775	470 0
Magnum Bonum	3 5	428 12
Up-to-date	1·15	100 31
Windsor Castle	0·55	55 10
Total	8·975	1,063 13

The average yield per acre amounted to a little over 113 maunds (4·3 tons) per acre against 155 maunds (5·7 tons) in 1914.

Besides these 1,063 maunds, some 50 maunds of potatoes of the four varieties mentioned above were obtained from the variety experiment. Out of this total of 1,113 maunds, some 620 maunds or 60 per cent. comprising tubers of medium size will be available for seed. The larger tubers will be sold off for table use and the smaller ones used for feeding the cattle on the farm.

The total outturn of potatoes grown last year (1914), taking the summer and winter crops together, was 2,196 maunds. It was disposed of as follows :—

	Mds.
Sold to Khasia cultivators	651
Supplied to Gauhati Seed-depôt and other places through the Deputy Director of Agriculture ...	342
Sold direct from the farm to officials and private individuals outside Khasi Hills	69
Total quantity supplied for seed ...	1,062
Used on the farm for planting	335
Fed to farm stock	375
Dryage and rottage	424
Total	2,196

The price charged to Khasia cultivators was the market price for table potatoes for the time being and varied last year between Rs. 2 and Rs. 2-8 per maund against Rs. 3-4 charged in the preceding year.

The potatoes had to be kept long in store awaiting sale with the result that a larger proportion than usual was spoiled through rotting. The surplus after sale was utilised in feeding the cattle and sheep on the farm as a partial substitute for oilcake and grain, and they appeared to thrive well on this food.

The 1,062 maunds of seed potatoes sold consisted of 593 maunds of King of Potatoes, 448 maunds of Magnum Bonum and 21 maunds of the minor varieties.

Manure experiment on peaty soil.

7. This experiment was designed to test the effect of lime and bonemeal on the peaty soil in the bottom of the valley. Two large plots were selected for the purpose early in the year 1914. The land had been a marsh and was reclaimed by draining. Each of the two plots was divided into four equal areas and the four sub-plots were treated in the spring of 1914 as follows :—

Sub-plot 1.—Manured with 30 maunds of lime per acre.

Sub-plot 2.—Manured with 30 maunds of lime and 3 maunds of bonemeal per acre.

Sub-plot 3.—Manured with 3 maunds of bonemeal per acre.

Sub-plot 4.—No manure.

N. B.—One maund = 80 lbs. roughly.

One of the two plots which had an area of $1\frac{1}{20}$ acres was sown with soybean in May 1914, and the other plot having an area of $\frac{7}{20}$ acre was sown at the same time with maize. The land in each case had received several ploughings during the preceding winter and spring, but remained still in a more or less sour condition even in those sub-plots which had received lime.

At the time of the last Annual Report, the soybean and maize were on the ground. The maize crop grew so poorly that it was not thought worth while to harvest it. It evidently suffered too much from the acidity of the soil.

The soybean grew up with great vigour; it was, however, found very slow in flowering and when ultimately it did begin to flower and set fruit, it was cut down by frost. The crop was, therefore, pulled up and turned into hay. The yield of hay was as follows :—

Sub-plot.	Manure used per acre.	Outturn of hay per acre.	
1	2	3	
		Mds.	Srs.
1	Lime 30 maunds	20	21
2	Lime 30 maunds and bonemeal 3 maunds.	23	24
3	Bonemeal 3 maunds	27	0
4	No manure	7	21

The land having been newly reclaimed from waste there was no means of knowing if the four sub-plots were of uniform fertility. They also suffered somewhat unequally from surface wash. The foregoing figures, however, leave no doubt as to the beneficial action of the lime and bonemeal on the soil.

Warping of rice-land.

8. Experience for two years' running showed that some land which had been reclaimed two years ago from a marsh for the purpose of rice cultivation was still unfit for the crop. The sterility of the soil was believed

to be due to the fact that the upper layer of the soil was mostly composed of tough grass roots which were slow to decay and it contained very little of what might be called real soil. An experiment was made during the year to see if the land could be brought into a fit condition for growing rice by a process known as "warping" which consists in covering the land with a layer of soil deposited from water. This method is used by the Khasias for renovating worn-out rice land.

One acre of land out of the area reclaimed in 1912-13 was taken for the purpose of this experiment. A slow current of water laden with soil thrown into it at a higher level was made to flow over the land. By shifting the current from place to place, the whole area was gradually got to be covered with a layer of silt about 3" thick. It was a rather costly operation, having cost no less than Rs. 128 for the one acre of land.

The land which is divided into ten equal plots of $\frac{1}{10}$th of an acre each was subsequently sown with wet rice. The crop is still young. It does not look very promising, though decidedly better than the crop of 1914.

New crops.

9. *American maize.*—It was mentioned in the last Annual Report that out of five varieties of American maize which were tried in 1913, all failed except one—Early Huron Dent—which produced a small quantity of grain. This was saved for seed and was sown in the spring of 1914. The germination was very poor and the few plants that came up grew miserably and produced no grain. The experiment to grow American corn was, therefore, a complete failure.

Buck Wheat.—This crop has been recently introduced into the district by Nepalese settlers. It was grown last year on $\frac{3}{16}$ acre of land on the farm and immediately followed a crop of potatoes. No extra cultivation was needed, the seed being merely scattered on the land as soon as the potatoes had been dug out. The crop grew well and was harvested about the end of October, just two months after it had been sown. The yield of grain amounted to 6 maunds per acre. The crop is likely to become popular among the Khasias.

Rhubarb.—The crop was planted in October 1912 and occupies about $\frac{1}{10}$-th acre. The land was manured last winter (1914-15) with 300 maunds of cowdung per acre. The plants came up with great vigour and last spring we were able to take off no less a quantity than 5 maunds 39 seers of stalks which sold for Rs. 58-4. A fresh area of 200 square yards was planted with rhubarb during the year. The plants are growing well.

Asparagus—Was planted in October 1912, and occupies one-third of an acre. The plot was manured last winter with cow-dung at the rate of 300 maunds per acre. We made the first pickings last spring. The total quantity of shoots obtained was 24 seers which was sold for Rs. 18.

Strawberries.—Drought in April and excessive rain in May were responsible for the failure of the last strawberry crop on the farm. Only 7lbs. of fruit was obtained from an area of 470 square yards (nearly $\frac{1}{10}$th of an acre).

10. The following fodder crops were grown during the year :—

Fodder crops.

Name of crop.	Area sown.	Cost of cultivation.	Outturn of green fodder.
1	2	3	4
	Acres.	Rs. a. p.	Mds. Sr.
Maize	7·7	254 13 8	900 24 (=33·1 tons.)
Jobs' tears	0·4	10 1 1	34 9 (=1·2 tons).
Langtylli and other native grasses	2·17	26 7 1	122 37 (=4·5 tons).
Total ...	10·27	291 5 10	1,057 30 (=38·8 tons.)

The maize crop gave a satisfactory yield. Jobs' tears did not grow well on account of the land not having received enough cultivation. The *Langtylli* grass which was planted in 1910 and seemed quite promising in the beginning gradually dwindled away and gave very little fodder during the year. It has since been uprooted.

The whole of the fodder (1,057¾ mds.) was placed in a circular pit for ensilage. Out of this quantity 681½ mds. or 64·42 per cent. was recovered as ensilage. It proved to be of excellent quality. There was very little loss through rottage on the sides. The total cost of the silage was Rs. 338-2-4, being made of Rs. 291-5-10 which was the cost of cultivation and Rs. 46-12-6 which was spent in chopping up the fodder and packing it in the silo. The cost per maund of silage amounted to 8¼ annas against 14 annas in the preceding year.

The only crop grown for hay was *Raishan* (Paspalum Sanguinale), a millet extensively grown on the plateau of the Khasi Hills. It has been successfully grown as a hay crop since 1912 and proved a valuable winter food for the cattle. During the year, a total area of 30·04 acres was sown with *Raishan*. The crop grew well on most of the area sown and gave a fair yield of hay. The weather in October being much drier than usual proved particularly favourable for hay-making. The total outturn of hay was 695 mds. 28 seers (25·5 tons). The cost of cultivation and hay-making amounted to Rs. 726-3-2 or a little over Re. 1 per maund of hay against Re. 1-6-6 in the preceding year. The hay was pronounced by all who saw it to be of excellent quality.

Cattle-breeding.

11. The following table shows the number of cattle in the herd on 30th June 1915.

Table showing the number of cattle in the herd on 30th June 1915.

Description.	Patna (P).	Bhutia (B).	P × B.	P × B × P.	P × B × P × P.	P × Khasi (K).	P × K × P.	Total on 30th June 1915.	Total on 30th June 1914.	Total on 30th June 1913.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
Breeding Bulls	2	...	...	...	...	...	...	2	2	2	
Bulls (3 years and above) ...	1	...	...	...	..	2†	...	3	11	9	†Are being used as plough cattle.
„ (2 to 3 years)	2	...	2	1	...	...	...	5	5	4	
„ (1 to 2 years)	2	...	...	...	...	...	...	2	4	6	

Table showing the number of cattle in the herd on 30th June 1915 —concld.

Description.	Patna (P).	Bhutia (B).	P × B.	P × B × P.	P × B × P × P.	P × Khasi (K).	P × K × P.	Total on 30th June 1915.	Total on 30th June 1914.	Total on 30th June 1913.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12
Bulls (under 1 year)	5	...	1	3	1	...	...	10	2	6	
Heifers (2 to 3 years)	2	...	...	1	2	...	...	5	3	4	
,, (1 to 2 years)	1	...	1	4	3	...	...	9	6	5	
,, (under 1 year)	5	...	...	1	1	...	...	7	9	4	
Cows	11	1	5	2	2	...	...	21	17	16	
Total on 30th June 1915 ...	31	1	9	12	9	2	...	64	...	...	
Total on 30th June 1914 ...	25	1	9	17	1	2	4	...	59	...	
Total on 30th June 1913 ...	27	1	7	13	...	2	6	...	...	56	

In addition to the above, there were 3 Hindustani and 4 Khasi bullocks. The total number of cattle was, therefore, 74 against 67 on the 30th June 1914.

Twenty calves were born and seven animals died during the year against 21 and 12, respectively, in the preceding year. Only 3 calves were lost from white scour against 10 in 1913-14. The hand-feeding of calves which had been introduced three years ago was suspected to be the cause of excessive mortality among young stock and was replaced during the year by the ordinary practice of allowing the calves to take milk direct from their mothers.

The only cattle purchased during the year were 4 plough-bullocks imported from Jowai towards the close of the year.

There was a satisfactory demand for breeding bulls bred at Upper Shillong, as many as 12 having been sold during the year and one lent to the Co-operative Dairy at Sunamganj. More bulls could have been sold, if available. Of the 12 bulls sold, five were sold in the Khasi Hills, three went to Bengal, two were purchased by European planters in the Darrang district, one was sold to an Honorary Correspondent in Nowgong and one to the Hindustan Tea and Fishery Company's Dairy near Karimganj. The animal which was lent to the Sunamganj dairy died of rinderpest within a short time of its arrival there.

The total yield of milk during the year amounted to 2,830 gallons, out of which 928 gallons were fed to the calves and the remainder was sold at the rate of 16 lbs. for the rupee. Most of the cows were not milked during the winter, the calves being allowed to take all the milk. The cost of maintenance of the herd amounted to Rs. 5,119 against Rs. 5,805 in the previous year. The income from the sale of milk amounted to Rs. 1,052-15 against Rs. 700 in 1913-14, and the value of the cattle sold to Rs. 445 against Rs. 490 in the preceding year.

The half-English Patna cattle and the progeny of their cross with Khasia and Bhutia breeds have proved remarkably well adapted to the climate of the Khasi Hills. In respect of milking capacity, these cattle stand head and shoulders above any cattle on this side of India. Some of the cows on the farm have yielded over 20 lbs. of milk at the height of their flow and one reached up to 28 lbs. in a day.

In view of the great cost of maintaining the cattle at Upper Shillong, the proposal is sometimes made either to sell off the herd or to transfer it to some other locality where it can be maintained at a cheaper cost. I am not in favour of such a proposal. After many years of work, we have got together a fine stock of milch cattle the like of which is not to be seen within many hundred miles of Shillong and which promises to improve further by selection and crossing. It would be a comparatively easy matter to increase the herd so as to make it possible for us to sell cows and heifers to the public. There is a great demand for female stock bred at Upper Shillong, but we cannot afford to sell any at present. Some of our cows might easily fetch Rs. 200 or more if offered for sale.

The cost of maintaining the herd is undoubtedly excessive. It may be possible to reduce the expenditure by separating the cows from the rest of the herd and maintaining them purely with a view to profit.

That the Upper Shillong cattle have begun to be appreciated is evident from the growing desire of cow owners in the Shillong station for the services of bulls bred on the farm.

One of the two breeding bulls on the farm has become too old for service, and the other, though comparatively young, needs to be soon replaced in order to avoid the evil effects of inbreeding. An endeavour was made during the year to import a fresh bull from Patna, but it transpired that in consequence of indiscriminate breeding in recent years, cattle answering to the pure Patna type have become nearly extinct in that locality. We have been advised to import an Ayrshire bull for the farm and steps are being taken for the purpose.

Sheep-breeding.

12. The results of the sheep-breeding operations have been extremely disappointing. The flock has been gradually dwindling down. There were only 81 sheep at the close of the year against 136 on the same date in 1914 and 171 in 1913. The decrease was mainly due to a disease known as *Strongylosis* which is caused by a minute worm attacking the vital organs.

Forty-eight animals were burnt to death by an accidental fire. These animals had been all suffering from the disease mentioned above and were kept in a segregation shed at some distance from the farmstead. Few of them were expected to survive.

Apart from the outbreak of *Strongylosis*, there are other causes which make the plateau of the Khasi Hills unsuitable for sheep-breeding. There is no pasturage to be had during the winter and it has been found necessary to feed the sheep during the time on purchased food and grass brought up at great cost from lower elevations.

The climate too has proved unfavourable to the growth of wool, possibly because of its excessive humidity. The heaviest fleeces do not exceed one pound in weight.

The original Dumba stock is now nearly extinct, and the cross between the Dumba and the native sheep, though larger and more handsome than the latter, has proved extremely susceptible to disease.

The sheep-breeding experiment is likely to be discontinued. The matter is awaiting the orders of the authorities.

Distribution of seeds and implements.

13. The following were the seeds, plants and implements supplied to agriculturists during the year :—

—	Mds. srs.	Number.
1	2	3
Seed potatoes	1,062 7½	...
Rhubarb roots	...	22
Asparagus „	...	10
Strawberry plants	...	100
Pear grafts	...	36
Apple „	...	14
Oilcake for manure	0 25	...
Turnwrest plough	...	1
Link chain for same	...	30 feet
Spring harrow	...	2
Wheel cultivator and plough	...	1
New model Planet Jr. seed drill	...	1

The implements mentioned above were supplied to a well-to-do Khasia agriculturist of Maukhar.

Establishment.

14. The establishment remained the same as in the preceding year. The Farm Superintendent, Mr. L. Herrick Singh, continued to work well.

The clerk of the farm, Mr. L. L. Reade, was sent towards the close of the year as a Government scholar to the Agricultural College at Sabour, and his place has been taken by a new man.

One of the two apprentices, Mr. M. Smith, was appointed an Agricultural Officer for the North-East Frontier on the completion of his two years' training at the farm. The other apprentice also completed his training during the year, but his work and conduct having proved unsatisfactory, it was thought undesirable to offer him any permanent appointment in the Department.

Receipts and expenditure.

15. The total receipts, excluding the value of 667 maunds 17 seers of seed potatoes supplied to the Deputy Director of Agriculture for sale and demonstration, amounted to Rs. 2,858-13-3, of which Rs. 1,080-7-9 was derived from the sale of milk, Rs. 445 from the sale of cattle and Rs. 1,080-7-9 from the sale of potatoes direct from the farm. Adding to the above the value of the

seed potatoes supplied to the Deputy Director, *viz.*, of 667 maunds 17 seers at Rs. 2-8 per maund, the total income of the farm during the year would amount to Rs. 4,527-2-3 against Rs. 4,018 in the previous year.

The total expenditure amounted to Rs. 15,450-5-11 against Rs. 14,952-15-1 in the previous year. The increase was due wholly to the construction of a new godown for the storage of potatoes at a cost of Rs. 1,378.

B. C. BASU,

SHILLONG :
The 21st August 1915.

Special Officer, Agricultural Department, Assam.

ANNUAL REPORT ON THE FRUIT EXPERIMENT STATION, SHILLONG, FOR THE YEAR ENDING THE 30TH JUNE 1915.

1. *Introductory.*—The fruit station commenced work in October 1912. It is situated on the south side of the Jowai road, distant about a mile from Shillong. The elevation of the land is about 5,100 feet. The total area of the grant is 47·90 acres, of which little more than the 16¼ acres planted, is suitable for fruit growing.

2. *Lower Garden.*—The area planted 15′×15′ diagonally is 4¼ acres, of which 3½ acres was laid out in 1912-13 and ¾ acre in 1913-14. The soil of this block varies from light sandy loam lying above stone to heavier loam of good depth. The Standard and Bush Apple trees planted in 1912-13 put on a strong growth during the year and pruned out satisfactorily. The Expalier trees formed new branches where required. The growth of the Pyramid and Bush Pear trees formed well shaped trees. The Cordon and Upright trained trees were summer pinched and set good fruit spurs. The Plum trees planted on the lighter soil did not thrive and will be removed to stronger soil. The Cherry, Peach, and Fig trees are full of vigour. Several of the Currant and Gooseberry trees died, and it is doubtful if they can be grown successfully in this climate. All the Berries bore fruit on strong canes; the heavy rain in April damaged the fruit of the Loganberry, Lowberry, Phenomenal and Laxtonberry. The Giant Himalaya Berry of California, a large Blackberry, is flowering well, and the fruit should ripen in July—the Royal Raspberry canes planted, show promise of success. Other varieties have been planted experimentally. The pruning of this block was finished by the 13th January. All the trees were winter sprayed with Lime Sulphur solution. Spraying for Aphis was also done as necessary. The application of Kerosine oil was found to be as effective as Methylated spirits for Wolly Apple Aphis. Vaporite was used round the trees to rid the soil of insects. Heavy hailstorms on the 29th March and the 22nd April did a lot of damage; the first storm cut off all the blossom that was out, and the fruit that had set—the Pear trees, the most forward, were stripped off their leaves. The bark of the majority of the trees was damaged. This block of the orchard suffered most and a large quantity of

damaged fruit, chiefly Apples, had afterwards to be picked off. The Strawberry crop was lost entirely. Few Peaches escaped. The Plum trees suffered greatly ; practically all the buds being cut off. Several of the trees are only now throwing out new shoots. Of the Apple trees that suffered least, Bismarck, James Grieve, Lane's Prince Albert, Kerry Pippin, and Cox's Orange Pippin show promise of bearing a few good fruit. Of the Pear trees Dr. Jules Guyot, Marguerite Marillat, William bon Chretien, Louise Bonne of Jersey, Marie Louise d' Uccle, Fondante Thirriot have a few sound fruit remaining. The stone terracing successfully prevented wash of the soil. The tillage of the land was continued to September, and the surface of the orchard has been kept stirred once a month since March. The climate was very dry to the 23rd April. From that date the rainfall has been much above the average.

3. *Upper Garden.*—The area planted is 12½ acres, of which 10½ acres was planted in 1913-14 and 2 acres in 1914-15. It is divided into 5 blocks, *viz.* :—

Top Block.—Area 1¾ acres planted in 1913-14 with Bush Apple trees 15′×15′ diagonally.

North Block.—Area 1½ acres planted in 1913-14 with Standard Apple trees 34′×34′ diagonally, interplanted with Bush Apple trees 17′×17′.

South Block.—Area 1 acre planted with Bush Apple trees 15′×15′ diagonally—¾ acre planted in 1913-14—¼ acre planted in 1914-15.

East Block.—Area 7 acres planted with Standard Apple trees 34′×34′ diagonally, interplanted with Bush Apple trees 17′×17′—5½ acres planted in 1913-14—1½ acres planted in 1914-15.

West Block.—Areas 1¼ acre planted with Standard Pear trees 25′×25′ diagonally, interplanted with Bush Pear trees 12′ 6″×12′ 6″—1 acre planted in 1913-14—¼ acre planted in 1914-15.

The whole of the planted area has been fenced with Page's wire fencing. The soil is a good loam of about 12 inches depth, lying on a reddish sub-soil. A small area only has a hard pan sub-soil about 2½ feet from the surface.

The terracing of the planted area is nearly completed. It has been most successful in preventing the denudation of the soil by rainfall. The fruit trees planted this year were purchased from Messrs. Thomas Rivers and Sons, Sawbridgeworth, Herts ; Messrs. Stuart Low and Co., Bush Hill Park, Middlesex ; Messrs.

H. Merryweather and Sons, Ltd., Southwell Notts; Messrs. Seabrook and Sons, Chelmsford, Essex; George Pyne, Denver Nurseries, Topsham, Devon, and Messrs. Stark Bros., Louisiana Missouri, United States, America. The majority of the trees arrived in good condition. The first consignment arrived on the 21st December 1914 and the last consignment on the 10th May 1915. Planting was finished on the 20th May. Five hundred Paradise stock, and 1,800 Free stock, for Apple grafting were planted 3 feet apart in rows between the trees in the East Block. One thousand one hundred Quince stock and 900 Pear stock for Pear grafting were planted 3 feet apart in rows between the trees in the West Block.

The following trees are in Nurseries for future extension:—

Standard Apple Trees	...	...	...	580
Bush „ „	...	...	...	1200
Standard Pear „	...	...	...	180
Cherry „	...	...	...	24
Apricot „	...	...	...	6
Walnut „	...	...	...	12
Plum „	...	...	...	80
Almond „	...	...	...	30
Sweet Chestnut „	...	...	...	10
Pecan Nut „	...	...	...	10

The trees on the Upper Garden suffered less from hail than those of the Lower Garden and many of the 1913-14 planted trees are bearing good fruit.

The following varieties blossomed and set fruit well:—James Grieve, Rev. W. Wilks; Sturmer Pippin, Kerry Pippin, Williams' Favourite; Bismarck; Golden Spire; Encore, Houblon; Lane's Prince Albert; Baumann's Reinette, Barnack Beauty, Thomas Rivers. All the trees put on good growth and promise well.

The two Khasi apprentices have worked very satisfactorily and take every interest in their work.

The establishment consists of an Overseer on a monthly salary of Rs. 25 and 8 Khasi gardeners on a monthly salary of Rs. 15 each.

4. *Varieties planted.*—The following statement shows the number and varieties of fruit trees planted :—

Species of fruit trees.	Variety.	Planted 1913-14-15.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	James Grieve ...	61	78	149	58	6	45	397	Bush.
	Boston Russet ...	...	2	12	...	...	...	14	
	Bens Red	...	...	10	10	...	9	29	
	Alfriston	...	...	30	...	...	9	39	
	Egremont Russet ...	10	...	...	8	...	...	18	
	Annie Elizabeth ...	...	...	20	...	...	...	20	
	Claygate Pearmain ...	10	...	...	10	...	...	20	
	Lord Hindlip ...	...	...	10	...	...	...	10	
	Mannington Pearmain	6	...	...	8	4	...	18	
	Winter Queening of Kent.	...	...	10	...	...	...	10	
	Pineapple Russet ...	...	...	...	9	...	...	9	
	Edward VII ...	...	...	...	10	...	...	10	
	Red Juneating ...	6	...	...	4	...	10	20	
	Flower of Kent ...	...	...	8	...	...	...	8	
	Barnack Beauty ...	...	...	...	6	6	...	12	
	Coronation ...	...	...	6	...	...	...	6	
	Wealthy	...	...	...	6	6	...	12	
	Feltham Beauty ...	...	...	10	...	...	...	10	
	Norfolk Beauty ...	9	...	...	10	...	10	29	
	Christmas Pearmain...	...	...	10	...	...	...	10	
	Yorkshire Beauty ...	5	...	...	1	...	...	6	
	Kings Acre Pippin ...	...	...	6	...	...	...	6	
	Crimson Bramley ...	15	...	19	...	...	5	39	
	Royal Snow ...	...	...	10	...	...	...	10	
	Bramley's Seedling ...	15	...	15	...	5	12	47	
	Kings of Tompkins County.	1	...	7	2	...	...	10	
	Houblon	...	...	6	...	...	...	6	
	Roundway Magnum Bonum.	6	...	...	...	...	3	9	
	Wellington ...	...	...	5	...	...	...	5	
	Lane's Prince Albert...	15	...	22	...	...	10	47	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1913-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Stirling Castle ...	10	...	10	...	...	...	20	Bush
	Golden Russet ...	...	...	6	...	...	...	6	
	Charles Ross ...	10	...	10	...	...	...	20	
	Bismarck	...	...	17	8	...	6	31	
	Rymer	6	...	...	...	...	...	6	
	Warner's King ...	...	...	...	...	...	11	11	
	Thomas Rivers ...	10	...	...	...	...	...	10	
	Grenadier	...	1	17	...	...	...	18	
	Rev. W. Wilks ...	20	...	6	...	...	6	32	
	Hounslow Wonder ...	...	1	21	...	...	6	8	
	Newton Wonder ...	15	...	21	...	...	10	46	
	Red Victoria ...	...	...	11	...	...	10	21	
	Potts' Seedling ...	5	...	5	...	...	10	20	
	Hector McDonald ...	...	...	20	...	...	10	30	
	Domino	15	...	...	...	...	...	15	
	Rival	...	...	16	...	...	...	16	
	Wadhurst Pippin ...	10	...	...	...	...	...	10	
	Court Pendu Plat ...	6	...	6	...	...	...	12	
	Ecklinville Pippin ...	5	...	5	...	...	...	10	
	Early Red Margaret...	...	...	10	...	...	...	10	
	Gascoyne's Scarlet ...	5	2	5	...	...	...	12	
	Spitzenberg ...	...	...	6	...	...	...	6	
	Braddicks Nonpareil...	6	...	...	...	...	...	6	
	White Nonpareil ...	10	...	...	...	...	...	10	
	Baumann's Reinette...	6	7	8	...	...	...	21	
	Pitmaston Pineapple...	10	...	...	...	...	...	10	
	Brownlee's Russet ...	10	...	...	...	...	...	10	
	Sturmer Pippin ...	6	6	16	...	...	9	37	
	Cardinal	...	...	9	1	...	...	10	
	Emneth Early ...	...	...	16	...	...	...	16	
	Langley Pippin ...	...	...	10	...	...	...	10	
	Wagener	...	...	9	...	...	...	9	
	Williams' Favourite ...	10	...	...	...	...	...	10	
	Scarlet Nonpareil ...	...	...	10	...	...	14	24	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Reinette doree de Heusgen.	10	...	...	...	...	...	10	Bush.
	Coe's Golden Drop ...	...	...	...	...	...	6	6	
	Cox's Orange Pippin...	...	...	...	...	24	...	24	
	Kerry Pippin ...	...	10	16	...	...	10	36	
	Sansparell... ...	...	...	...	...	6	...	6	
	Golden Reinette ...	...	...	...	...	...	6	6	
	Peasgood Nonesuch ...	...	...	26	...	6	9	41	
	Fearn's Pippin ...	...	...	12	...	...	6	18	
	Lady Sudeley ...	...	2	20	...	4	6	32	
	Devonshire Quarrenden	...	...	...	...	...	18	18	
	Duke of Devonshire ...	...	...	...	...	6	...	6	
	Yellow Ingestre ...	...	...	...	...	...	6	6	
	Allen's Everlasting ...	...	...	...	...	6	...	6	
	Ardcairn Russet ...	...	...	6	...	...	5	11	
	Allington Pippin ...	...	16	5	...	4	...	25	
	William Crump ...	...	...	20	...	...	6	26	
	Worcester Pearmain...	...	...	...	...	6	...	6	
	Herring's Pippin ...	...	...	3	...	...	1	4	
	Beauty of Bath ...	...	1	6	...	6	...	13	
	Ellison Orange ...	...	...	...	...	...	1	1	
	Ribston Pippin ...	...	...	...	...	12	...	12	
	Charles Eyre ...	...	...	3	...	...	1	4	
	Syke House Russet ...	...	...	...	...	6	...	6	
	Spring Ribston Pippin	...	2	8	...	...	...	10	
	Mr. Gladstone ...	...	...	7	...	5	...	12	
	Golden Spire ...	...	14	...	...	...	...	14	
	Rosemary Russet ...	...	...	6	...	6	...	12	
	Early Peach ...	...	10	...	...	...	...	10	
	Yellow Newtown Pippin.	...	4	8	...	6	...	18	
	American Mother ...	...	9	...	...	...	...	9	
	Cox's Pomona ...	...	1	...	...	...	...	1	
	Encore	...	...	18	...	4	...	22	
	Irish Peach ...	...	6	...	...	...	...	6	
	Total ...	344	172	799	151	134	286	1,886	

Species of fruit trees	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees	Crimson Bramley	...	...	6	10	...	...	16	Standards.
	Rhymer	...	...	...	...	...	8	8	
	Bramley's Seedling	...	...	8	14	...	...	22	
	Court of Wick	...	...	6	...	...	...	6	
	Irish Peach	...	...	...	6	...	...	6	
	Northern Greening	...	...	...	...	...	8	8	
	Norfolk Beefing	...	...	...	6	...	...	6	
	Newton Wonder	...	...	18	...	...	...	18	
	Stirling Castle	...	...	5	1	...	5	11	
	Duchess of Oldenburg	...	...	6	...	...	...	6	
	Norfolk Bearer	...	...	5	1	...	...	6	
	King of Tompkins County.	...	...	6	...	...	...	6	
	Emperor Alexander	...	...	...	6	...	...	6	
	James Grieve	...	...	18	...	...	...	18	
	Cox Pomona	...	...	2	4	...	...	6	
	Small's Admirable	...	...	6	...	...	...	6	
	New Hawthorden	...	...	6	...	...	...	6	
	Delicious (Starks)	...	...	12	...	...	...	12	
	King David ,,	...	...	12	...	...	...	12	
	York Imperial ,,	...	...	6	...	...	...	6	
	Paragon Winesap ,,	...	...	5	...	...	...	5	
	Jonathan ,,	...	...	6	...	...	...	6	
	Black Ben ,,	...	...	6	...	...	...	6	
	Stayman Winesap ,,	...	...	7	...	...	...	7	
	Senator ,,	...	...	6	...	...	...	6	
	Grimes Golden ,,	...	...	5	...	...	...	5	
	Mother ,,	...	...	6	...	...	...	6	
	Emneth Early	...	...	10	...	...	...	10	
	Baumann's Reinette	...	...	10	...	...	...	10	
	Grenadier	...	...	9	...	...	...	9	
	Cox's Orange Pippin	...	...	16	...	...	...	16	
	Blenheim Orange	...	...	9	...	...	...	9	
	Calville Blanc	...	...	6	...	...	...	6	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Lady Henniker ...	...	...	6	...	...	...	6	Standards.
	Golden Spire ...	...	...	6	...	...	...	6	
	Bismarck	...	...	6	...	...	...	6	
	Calville Rouge d' hiver	...	...	...	...	1	...	1	
	Early Melon (Starks)...	...	...	6	...	...	...	6	
	Wealthy („) ...	...	...	12	...	...	...	12	
	Wilson's Red June (Starks).	...	...	6	...	...	...	6	
	Liveland Raspberry (Starks).	...	...	6	...	...	...	6	
	Total ...	...	...	271	48	1	21	341	
	Blenheim Orange ...	...	...	2	11	...	...	13	Horizontal trained.
	James Grieve ...	...	...	...	...	4	...	4	
	Feltham Beauty ...	...	...	2	3	...	...	5	
	Lady Sudeley ...	2	...	...	...	3	...	5	
	Herring's Pippin ...	...	...	2	1	...	...	3	
	Gascoyne's Scarlet ...	3	...	...	...	...	...	3	
	Charles Ross ...	3	...	...	...	...	...	3	
	Brownlees Russet ...	3	...	...	...	2	...	5	
	Baumann's Reinette...	3	...	...	...	...	...	3	
	Beauty of Bath ...	...	...	...	...	5	...	5	
	Sturmer Pippin ...	6	...	...	...	...	...	6	
	Cox's Orange Pippin...	...	...	...	...	...	1	1	
	Cox Pomona ...	1	...	...	...	3	...	4	
	King of the Pippins...	...	...	3	...	...	2	5	
	Kerry Pippin ...	...	...	...	...	...	1	1	
	Claygate Pearmain ...	...	...	...	...	...	1	1	
	King of Tompkins County.	...	...	3	...	...	...	3	
	Total ...	21	...	12	15	17	5	70	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Sturmer Pippin ...	...	...	...	3	...	...	3	Upright trained.
	Mannington Pearmain	...	...	...	3	...	...	3	
	Scarlet Golden Pippin	...	...	...	...	...	2	2	
	Washington ...	2	...	2	2	...	...	6	
	Allington Pippin ...	...	...	...	...	...	2	2	
	Golden Spire ...	...	...	1	...	...	...	1	
	Beauty of Bath ...	...	...	...	...	...	2	2	
	Adams Pearmain ...	2	...	...	1	...	...	3	
	James Grieve ...	...	...	...	...	...	2	2	
	King of the Pippins...	...	...	1	1	...	...	2	
	Barnack Beauty ...	...	...	...	...	...	2	2	
	King of Tompkins County.	...	...	...	6	...	...	6	
	Total ...	4	...	4	16	...	10	34	
	Charles Ross ...	...	...	6	...	...	...	6	Palmette Verrier trained.
	Rival	...	...	6	...	...	...	6	
	James Grieve ...	...	...	6	...	...	...	6	
	Blenheim Orange ...	...	...	6	...	...	...	6	
	Total ...	...	...	24	...	...	...	24	
	Baumann's Reinette...	4	...	...	...	...	...	4	Fan trained.
	Golden Spire ...	1	...	...	...	...	...	1	
	Total ...	5	...	...	...	...	...	5	

Species of fruit trees.	Variety.	Planted for 1913-14-15.				Planted 1912-13.	Total Number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Fertility	...	55	...	...	19	74	Bush and Pyramid.
	St. Swithins ...	...	...	...	...	10	10	
	Beurre Hardy ...	...	16	...	...	...	16	
	Red October ...	...	...	...	...	10	10	
	Beurre d' Anjou ...	...	6	...	...	...	6	
	Parrot	...	...	...	...	10	10	
	William's Bon Chretien	...	13	...	...	...	13	
	Seedling Bergamot ...	...	...	...	...	6	6	
	Fondante Thirriot ...	...	10	...	...	10	20	
	Dr. Hogg	...	...	...	...	9	9	
	Triomphe de Vienne...	...	6	...	...	...	6	
	Beacon	...	...	...	...	8	8	
	Beurre de Naghan ...	...	...	...	...	6	6	
	Charles Ernest ...	...	12	...	...	...	12	
	Roosevelt	...	...	...	...	6	6	
	Doyenue d' Ete ...	...	10	...	...	...	10	
	Blickling	...	...	...	...	6	6	
	Gansels Bergamot ...	...	6	...	...	...	6	
	Santa Claus ...	...	...	...	...	6	6	
	Josephine de Malines...	...	6	...	...	9	15	
	Precoce de Juillet ...	...	...	...	...	6	6	
	Dr. Jules Guyot ...	...	12	...	...	6	18	
	Madame Treyve ...	...	...	...	...	10	10	
	Durondeau ...	...	7	...	...	5	12	
	Hessle	...	5	...	1	13	19	
	Beurre d' Amanlis ...	...	12	...	...	10	22	
	Emile d' Heyst ...	...	5	...	...	10	15	
	Marie Benoist ...	...	6	...	...	...	6	
	Clapp's Favourite ...	...	5	...	...	10	15	
	Louise Bonne of Jessey	...	2	...	...	...	2	
	President Barabe ...	...	5	...	...	...	5	
	Thompson ...	...	5	...	...	...	5	
	Winter Nelis ...	...	4	...	...	...	4	
	Marguerite Marillat ...	...	6	...	...	...	6	

Species of fruit-trees.	Variety.	Planted for 1913-14-15.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Colmar d' Ete ...	...	6	...	...	...	6	Bush and Pyramid.
	Princess	...	6	...	...	...	6	
	Belle Julie ...	...	6	...	...	...	6	
	Total ...	...	232	...	1	185	418	
	Beurre Hurdy ...	...	14	...	...	5	19	Single Cordon.
	Clapp's Favourite ...	...	10	...	...	...	10	
	Durondeau ...	...	8	...	...	...	8	
	Madame Treyve ...	...	10	5	...	...	15	
	William's Bon Chretien ...	...	9	...	...	5	14	
	Marguerite Marillat ...	...	12	...	...	5	17	
	Doyenne du Comice ...	...	10	...	...	5	15	
	Fondante Thirriot ...	...	...	5	...	...	5	
	Louise Bonne of Jersey ...	...	10	...	...	5	15	
	Conference ...	...	9	...	...	5	14	
	Emile d' Heyst ...	...	9	...	...	...	9	
	Winter Nelis ...	...	5	...	...	...	5	
	Fondante d' Antomme ...	...	...	5	...	...	5	
	Beurre Superfin ...	...	...	...	...	5	5	
	Princess	...	...	5	...	5	10	
	Beurre Fonqueray ...	...	...	5	...	...	5	
	Beurre Diel ...	...	...	...	...	5	5	
	Directeur Hardy ...	...	...	5	...	...	5	
	Beurre d' Anjou ...	...	...	...	...	5	5	
	Colmar d' Ete ...	...	...	5	...	...	5	
	Total ...	...	106	35	...	50	191	
	Directeur Hardy ...	...	5	...	...	...	5	Horizontal trained.
	Duchess d' Angouleme ...	...	1	...	...	...	1	
	Clapp's Favourite ...	...	2	...	...	...	2	
	Josephine de Malines ...	...	1	...	...	...	1	
	Emile d' Heyst ...	...	2	...	...	...	2	
	Louise Bonne of Jersey ...	...	1	...	...	...	1	
	Beurre Superfin ...	...	1	...	...	...	1	

Species of fruit trees.	Variety.	Planted for 1913-14-15.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Princess	...	6	...	...	...	6	(Horizontal trained).
	Conference ...	...	2	...	...	...	2	
	Dr. Jules Guyot ...	...	2	...	...	...	2	
	Durondeau ...	...	1	...	...	...	1	
	Pitmaston Duchess ...		1	...	...	...	1	
	Fondante d' Automme	...	1	...	...	...	1	
	Doyenne du Comice ...	...	2	...	...	...	2	
	Winter Nelis ...	4	...	...	...	...	4	
	Marguerite Marillat ...	...	5	...	...	...	5	
	Total ...	4	33	...	...	...	37	
	King Karl (Starks) ...	...	1	...	...	...	1	Standards.
	Triumph ,, ...	...	2	...	...	...	2	
	Anjou ,, ...	...	6	...	...	...	6	
	Lincoln ,, ...	...	4	...	...	...	4	
	Howell ,, ...	...	7	...	...	...		
	Duchess ,, ...	...	6	...	...	...	6	
	Bartlett ,, ...	...	8	...	...	...	8	
	Seckle ,, ...	...	6	...	...	...	6	
	Marie Louise ...	...	2	...	...	...	2	
	Dr. Jules Guyot ...	...	1	...	...	...	1	
	Conference ...	...	2	...	...	...	2	
	Emile d' Heyst ...	...	1	...	...	...	1	
	Madame Treyve ...	...	8	...	...	...	8	
	Count de Lamy ...	...	3	...	...	...	3	
	Louise Bonne of Jersey	...	2	...	...	...	2	
	Beurre Capaumont ...	...	4	...	...	...	4	
	Princess	...	2	...	...	...	2	
	Doyenne du Comice ...	...	2	...	...	...	2	
	William's Bon Chretien	...		...	...	...	2	
	Souvenir du Congres...	...	2	...	...	...	2	
	Marie-Louise d' Uccle	...	2	...	...	...	2	
	Fertility	...	4	...	...	...	24	
	Total ...	...	97	...	...	...	97	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	West block.	East block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Pear trees	Princess	...	5	...	...	...	5	Upright trained.
	Conference ...	...	...	...	...	3	3	
	Madame Treyve ...	...	...	5	...	...	5	
	Marie Louise d' Uccle ...	...	...	...	...	4	4	
	Louise Bonne of Jersey ...	...	...	...	...	4	4	
	Bourre Hardy ...	5	...	...	...	...	5	
	Fondante d' Autommne ...	...	...	...	...	3	3	
	Winter Nelis ...	...	...	...	4	...	4	
	Conseiller de la Cour ...	...	...	...	...	3	3	
	Doyenne du Comice ...	...	...	...	...	3	3	
	Marguerite Marellat ...	4	2	...	...	...	6	
	Total ...	9	7	5	4	20	45	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Plum trees ...	Late Transparent ...	...	...	...	...	6	...	6	Bush.
	Deniston's Superb Gage.	...	...	...	...	...	10	10	
	Satsuma	...	...	...	...	1	...	1	
	Jefferson	...	...	...	...	3	...	3	
	Belle de Louvain ...	...	...	...	...	...	6	6	
	Curlew	...	...	...	...	1	...	1	
	Greengage ...	...	...	...	...	6	5	11	
	Bittern	...	...	...	...	1	...	1	
	Cox's Emperor ...	...	...	...	...	...	6	6	
	Monarch	...	...	3	...	...	...	3	
	Stark's Gold ...	3	...	...	...	...	...	3	
	Belgian Purple ...	...	...	...	...	...	10	10	
	Rutland Plumcot ...	1	...	...	...	...	...	1	
	Pond's Seedling ...	...	...	...	...	3	6	9	
	Stark's Shiro ...	1	...	...	...	...	...	1	
	Early Transparent ...	...	...	...	...	...	5	5	
	Stark's Omaha ...	...	...	1	...	1	...	2	
	Autumn Beauty ...	...	...	1	...	...	3	4	
	Guthrie's Late Gage ...	...	...	...	...	...	5	5	
	Reine Claude de Bavay ...	...	...	...	...	...	4	4	
	Victoria	...	...	...	...	...	9	9	
	Czar	...	...	...	...	...	6	6	
	King of the Damsons ...	...	...	...	...	3	...	3	
	Shepherd's Bullace ...	...	...	...	...	3	...	3	
	Langley's Bullace ...	...	...	...	...	3	...	3	
	White Damson ...	...	...	...	...	3	...	3	
	Prune Shropshire ...	...	...	...	...	3	...	3	
	Merryweather Damson	...	...	...	...	6	...	6	
	Stark's America ...	...	...	2	...	...	...	2	
	Total ...	5	...	7	...	43	75	130	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Plum trees ...	Decaise	...	...	...	...	1	...	1	Fan trained.
	Kirkes	...	...	...	...	2	...	2	
	Jefferson	...	...	...	...	2	...	2	
	Mallard	...	...	...	...	1	...	1	
	Golden Esperen ...	...	...	...	...	1	...	1	
	Oullin's Golden Gage...	...	...	...	...	2	...	2	
	Reine Claude d'Althan	...	...	...	...	1	...	1	
	Early Transparent ...	...	...	...	...	1	...	1	
	Coe's Golden Drop ...	...	...	...	...	1	...	1	
	Transparent Gage ...	...	...	...	...	1	...	1	
	Grcengage ...	...	...	...	...	2	...	2	
	Golden Transparent Gage.	...	...	...	...	1	...	1	
	Belgian Purple ...	...	...	...	...	1	...	1	
	Total ...	...	...	...	...	17	...	17	
Cherry trees ...	Morello	...	...	...	...	3	...	3	Trees.
	Kentish	...	...	...	...	...	16	16	
	Bigarreau Kentish ...	...	...	...	...	...	6	6	
	Gloire de France ...	...	...	...	...	...	5	5	
	White Heart ...	...	...	...	...	...	5	5	
	Napoleon	...	1	...	...	...	...	1	
	Black Heart ...	...	...	...	...	...	6	6	
	Lambert	...	1	...	...	...	...	1	
	Montmorency King ...	...	1	...	...	...	...	1	
	Montmorency Monarch	...	3	...	...	...	...	3	
	Turkey Black Heart...	...	...	...	...	1	...	1	Fan trained.
	Late Black Bigarreau	...	...	...	...	1	...	1	
	Frogmore Bigarreau...	...	...	...	...	1	...	1	
	Noir de Guben ...	...	...	...	...	1	...	1	
	Belle de St. Trone ...	...	...	...	...	1	...	1	
	Early Rivers ...	...	...	...	...	1	...	1	
	Kashmir	...	8	...	...	...	...	8	
	Total ...	...	14	...	...	9	38	61	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Orange trees ...	Japanese Satsuma ...	...	...	...	...	2	...	2	Trees.
	Japanese Kumquot ...	...	4	...	...	8	...	12	
	Malta Blood ...	...	4	...	...	3	2	9	
	St. Michael's ...	...	...	...	...	4	...	4	
	Jaffa	...	...	...	...	1	3	4	
	Malta Oval ...	...	...	...	...	2	1	3	
	Silver	...	1	...	...	1	3	5	
	Excelsior	...	...	...	...	2	...	2	
	St. Michael's Tangierin.	...	...	...	...	...	6	6	
	St. Michael's Dom Louise.	...	...	...	...	3	...	3	
	St. Machael's Sustain	...	...	...	...	1	1	2	
	Ditto Achilles	...	...	...	...	...	1	1	
	Total ...	...	9	...	...	27	17	53	
Pumelow and Lemon trees.	Pumelow	...	...	...	...	5	...	5	
	Imperial Lemon ...	...	...	...	...	...	2	2	
	Bijou ,, ...	...	...	...	...	4	...	4	
	Total ...	...	...	...	...	9	2	11	
Walnut trees ...	Dwarf Prolific ...	...	...	...	...	...	10	10	
	Total ...	...	...	...	...	...	10	10	
Peach trees ...	Peregrine ...	...	...	...	...	4	14	18	
	Alexander... ...	...	...	...	...	3	11	14	
	Duke of York ...	...	...	...	...	1	16	17	
	Exquisite	...	...	...	...	...	3	3	
	Late Devonian ...	...	...	...	...	3	...	3	
	Lady Palmerston ...	...	...	...	...	3	...	3	
	Kestrel	...	...	...	...	6	...	6	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	South block.	East block.	North block.	Lower garden.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9	10
Peach trees ...	Hale's Early ...	...	...	...	...	3	...	3	Trees.
	Gladstone	...	...	...	...	1	...	1	
	Golden Rathripe ...	...	...	...	...	1	...	1	
	Alexander Noblesse ...	...	...	...	...	1	...	1	
	Waterloo	...	...	...	...	1	...	1	
	Goshawk	...	...	...	...	1	...	1	
	Total ...	...	...	...	...	28	44	72	
Apricot trees ...	Superb (Starks) ...	...	...	1	...	1	...	2	Trees.
	Blenheim	...	...	...	...	6	...	6	
	Wenatchee Moorpark (Starks).	...	1	...	...	...	...	1	
	Total ...	...	1	1	...	7	...	9	
Fig trees ...	White Marseilles ...	...	...	...	...	...	5	5	
	Bourjassotte Grise ...	...	...	...	...	...	5	5	
	Monaco Bianco ...	...	...	...	...	...	6	6	
	Total ...	...	...	...	...	...	16	16	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	West block.	North block.	Lower block.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Wineberry	.....	...	...	...	7	...	7	Berries.
Lowberry...	.....	...	...	...	...	6	6	
Rubus Crataegifolius.	.....	...	...	...	5	...	5	
King's Acre Berry.	.....	...	...	...	5	...	5	
Loganberry	.....	...	...	...	3	1	4	
henomenal	.....	...	...	...	3	1	4	
Laxtonberry	.....	...	...	...	5	...	5	
Blackberry	Blowers	...	...	...	4	...	4	
Ditto ...	Pyne's Giant Himalaya Berry of California.	...	...	...	12	...	12	
Raspberry	Pyne's Royal ...	...	...	...	20	...	20	
	Park Lane ...	...	...	...	8	...	8	
	November Abundance	...	...	...	7	...	7	
	Laxton's Bountiful ...	...	...	...	9	...	9	
	Pyne's Devon ...	...	...	...	10	...	10	
Strawberry	Givon's late Prolific...	...	...	...	...	900	900	Plants.
	Monarch ...	...	...	...	250	...	250	
	Louis Gauthier ...	...	...	...	...	350	350	
	Royal Sovereign ...	...	...	...	250	...	250	
	Laxton's Cropper ...	...	...	...	200	...	200	
	Total ...	...	...	...	700	1,250	1,950	
Currant bushes.	Raby Castle ...	...	...	...	2	...	2	Fan trained.
	White Dutch ...	...	...	...	4	...	4	
	Scotch Red ...	...	...	...	5	...	5	
	Boskoop Giant Black	...	...	...	2	...	2	
	Defender Black ...	...	...	...	1	...	1	
	Mervin Crystal White	...	...	...	4	...	4	
	Southwell's Black ...	...	...	...	50	...	50	
	Total ...	...	...	...	68	...	68	

Species of fruit trees.	Variety.	Planted 1913-14-15. Upper garden. Top block.	West block.	North block.	Lower block.	Planted 1912-13. Lower garden.	Total number.	Description.
1	2	3	4	5	6	7	8	9
Gooseberry trees.	Golden Drop Yellow	...	...	...	3	...	3	Gridiron trained.
	Keepsake Green ...	...	...	...	4	...	4	
	Couzen's Seedling Yellow. ...	...	...	...	1	...	1	
	Total ...	...	...	...	8	...	8	
Nut trees ...	White Filbert ...	...	...	...	3	...	3	Trees.
	Red Filbert ...	...	...	...	3	...	3	
	Prize Cob ...	...	...	...	3	...	3	
	Kentish Cob ...	...	...	...	3	...	3	
	Total ...	...	...	...	12	...	12	
Grape Vines.	Campbell's Early (Starks).	...	...	...	2	...	2	Vines.
	Hicks (Starks)	...	...	...	2	...	2	
	King ,, ...	...	...	...	2	...	2	
	Eclipse ,, ...	...	...	...	2	...	2	
	King Phillip ,, ...	...	...	...	2	...	2	
	Wilder ,, ...	...	...	...	2	...	2	
	Worden ,, ...	...	...	...	2	...	2	
	Total ...	...	...	...	14	...	14	

Summary of Fruit Trees planted to 30th June 1915.

	1912-13.	1913-14-15.	Total.
1	2	3	4
Bush Apple trees	286	1,600	1,886
Standard „	21	320	341
Horizontal trained Apple trees ...	5	65	70
Upright „ „ „ ...	10	24	34
Bush and Pyramid Pear „ ...	185	233	418
Single Cordon „ ...	50	141	191
Horizontal trained „ ...	...	37	37
Standard „ ...	...	97	97
Upright trained „ ...	20	25	45
Bush Plum trees	75	55	130
Fan trained Plum trees	...	17	17
Cherry trees	38	23	61
Orange „	17	36	53
Lemon „	2	9	11
Walnut „	10	...	10
Peach „	44	28	72
Apricot „	...	9	9
Fig „	16	...	16
Wineberry	...	7	7
Lowberry	6	...	6
Rubus Crataegifolius	...	5	5
Loganberry	3	1	4
King's Acre Berry	...	5	5
Phenomenal	3	1	4
Laxtonberry	...	5	5
Giant Himalaya Blackberry ...	...	12	12

	1912-13.	1913-14-15.	Total.
1	2	3	4
Blower's Blackberry	...	4	4
Raspberry	...	54	54
Strawberry plants	1,250	700	1,950
Currant Bushes	...	68	68
Gooseberry trees	...	8	8
Nut trees	...	12	12
Grape Vines	...	14	14

C. H. HOLDER,

The 29th July 1915.

In charge, Fruit Experiment Station, Shillong.

Statement showing the Receipts and Expenditure of the Fruit Experiment Station, Shillong, from 1st July 1914 to 30th June 1915.

Receipts.	Amount.	Expenditure.	Amount.
1	2	3	4
	Rs. a. p.		Rs. a. p.
Sale-proceeds of Timber...	213 0 0	Allowance to Superintendent	3,000 0 0
		Establishment ...	2,310 0 0
		Petty Construction ...	1,040 5 2
		Plants and Manures ...	5,326 8 4
		Instruments, Appliances and Machinery.	718 12 2
		Wages of Labourers ...	5,268 0 0
		Other charges ...	512 5 3
Total Receipts ...	213 0 0	Total Expenditure ...	18,175 14 11

ANNUAL REPORT OF THE KARIMGANJ AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1915.

General.

This station or farm came into being in January 1914. It is situated on the Sylhet road, 3½ miles to the west of the subdivisional station of Karimganj which lies on the Assam-Bengal Railway.

The total area of the farm is a little under 80 acres. Leaving out a compact block of about 8 acres which has been set apart for the farmstead and quarters for the staff, and the area covered by roads and drains, the net area available for cultivation amounts to about 68 acres.

The station is to be devoted mainly to experimental work on rice and jute.

Character of land and soil.

2. The station lies close to the Langai river which occasionally rises in high flood and lays the country all round under water. This liability to floods is characteristic of the rice lands in the locality.

The soil of the greater portion of the farm is a deep alluvial clay of fine texure, though not particularly heavy. In the higher lands, it is of comparatively lighter character and may be described as a medium loam. It has not yet been chemically analysed.

Equipment.

3. The farm was enclosed during the year with an "Ideal Woven Wire" fence at a cost of Rs. 2,731-2-3. This fence is proof against cattle as well as pigs and goats.

A small tank in addition to two others dug in the previous year was excavated at a cost of Rs. 300.

The following buildings were erected during the year: their cost is shown alongside :—

	Rs.
Combined office and inspection building	2,862
Quarters for 4 apprentices	1,493
Barn and threshing floor	2,322
Quarters for overseer	1,000
Latrine for coolies	239

All the works were executed under departmental management. The Executive Engineer, Sylhet, kindly gave his advice and assistance in designing and constructing the buildings.

The equipment of the station as regards house accommodation is now very nearly complete.

The farm was laid out during the year into fields and plots of convenient size, and a considerable length of roads, paths and drains was made. The drainage is, however, still in an unsatisfactory condition on account of the low nature of the ground. A small plot of land has been purchased at a cost of Rs. 20 for taking through it a drain from the residential part of the farm to a khal at some distance. The drain will be constructed as soon as the land will be dry enough for excavating earth. It will help to keep dry the ground round the houses and the farmstead which at present gets converted into a swamp in the rainy season.

The construction of the roads, paths and drains and the raising of some of the house sites cost a total sum of Rs. 1,330. The boundaries of the farm were demarcated during the year by means of 20 masonry pillars and 20 flag stones at a cost of Rs. 221-4-0. The demarcation was done under the supervision of the Revenue Kanungo of the subdivision.

Five pairs of plough cattle were purchased during the year at a cost of Rs. 500, bringing up the total strength of working cattle to 30 animals.

The following implements were purchased during the year:—

2 Meston ploughs at Rs. 5-8 each.

2 Hand cultivators at Rs. 12-8 each (Messrs. Burn & Co.).

1 Winnowing machine Rs. 230.

The costs shown above are exclusive of freight. The implements having arrived late in the season could not be used during the year.

Character of the year.

4. The official agricultural year is found extremely inconvenient for the purposes of report. It covers the latter half of one *kharif* season and the first half of the *kharif* season following, and includes, of course, the *rabi* season intervening between these two.

The following table shows the rainfall during each of these three periods :—

—	Actual.	Normal.
1	2	3
LAST HALF OF *Kharif* 1914.		
July 1914	20·96	23·11
August „	20·00	22·83
September „	17·32	18·58
October „	3·84	8·31
Total	62·12	72·83
Rabi, 1914-15.		
November 1914	...	1·31
December „	0·83	0·56
January 1915	0·40	0·75
February „	1·42	1·46
Total	2·65	4·08
FIRST HALF OF *Kharif* 1915.		
March 1915	2·97	8·80
April „	18·05	18·72
May „	42·83	21·19
June „	32·79	31·45
Total	96·64	80·16
Total for the year	161·41	157·07

The short rainfall of September and October and the utter absence of rain in November proved injurious to the winter rice crop which yielded barely a 10 anna outturn. An indirect result of the short rainfall in the rainy season of 1914 was the total absence of flood water which is necessary for the well-being of *asra* rice. The absence of the flood water brought on a disease called *lanka-pura* which destroyed a large proportion of that crop. The disease may be the effect of an excessive accumulation of soil toxics which in ordinary years is washed out by flood, but which cannot be got rid of when there is no flood.

The only *rabi* crop on the farm was some non-experimental pulse. It did not seem to be affected by the season one way or the other.

The present *kharif* season (1915) has been a disastrous one. March and the first part of April were drier than usual. The absence of rain at the time retarded the sowings of jute and *aus* rice. Then followed a long period of heavy rain which continued with slight interruptions right on to the end of the year and well on into July. The rainfall during May was twice as heavy as the normal, and it rained on 24 days out of the 31. Heavy precipitation also took place in the latter part of June and the first ten days of July. The heavy rainfall by itself did not cause any great injury to the standing crops, but it led to two successive floods—a moderately high one during the first part of June, and a second flood a month later, the like of which in point of height and suddenness has not been experienced within living memory. The first flood did considerable damage to the crops, both experimental and non-experimental, and those which survived that flood as well as the sowings made after that flood had retired were almost totally wiped out by the second flood. The only crop that survived the floods was jute. The experimental rice plots were totally wrecked. A little of the non-experimental rice has remained, and may still give a little outturn.

Rice breeding.

5. The main work of the station has been the line breeding of rice which was started last year and was proceeding smoothly when it was abruptly terminated by the floods of June and July last. As it is proposed to start the work afresh, it is necessary to describe briefly the lines on which the breeding experiment has been organized and the amount of work which, though lost for the most part, had been done. The lines on which the experiment is being conducted were settled in May 1914 in consultation with the Deputy Director and Mr. G. P. Hector, the Economic Botanist of Bengal.

Ordinary rice seed is usually found on examination to be a mixture of different types of unequal quality and productive power. Some of these types are pure, and therefore, breed true; others are the products of natural crossing and split into types differing in character and are consequently unreliable. The types also differ in regard to their productive power and other characters.

The method of breeding followed on the farm starts by growing in the first season from ordinary village seed as many local varieties of rice of each class as we can procure, and in picking out from each as many distinct types as we can detect while the crop is still standing in the field, each type being represented by the ripe ears taken from a single plant.

The next step is to grow the various lots of seed thus obtained in little plots side by side, first with the object of testing which of these types are constant and therefore pure and which again split as the result of previous crossing, and secondly, with the object of comparing the pure types in regard to yielding power and other characters. Though the rice flower is normally self-fertilized a certain amount of natural crossing is known to occur. A clear space of 3 to 6 feet around each little plot is kept in order to minimise the risk of intercrossing between adjacent types.

The next and third step is to take the pure types and grow them a second or even a third time (which is to be the work of the third or fourth season) in order to confirm the results of the second season as to their respective merits.

In this way at the end of the third or fourth season, we should be able to fix upon one or more of these pure lines as being more prolific and of better quality all round than the rest within their own class. The next and last step will be to propagate these selected pure lines on a field-scale for the purpose of distributing the produce as seed.

The experiment is being made with four classes of rice, namely, (1) early *aus* rice, which is usually grown broadcast and of which two crops may be taken in the course of a year, (2) transplanted *aus*, (3) *sail* or transplanted winter rice, and (4) *asra* which comprises the comparatively short-stemmed varieties of *amon* or swamp winter rice and which is capable of being grown either broadcast or transplanted.

Coming to each of these classes of rice, I note below the work done during the year under report.

Early aus.—This class comprises three sub-classes of rice, *viz.*, *murali*, *chengri* and *dumai*. These differ from each other in regard to the depth of water which they can stand during the later stages of growth and the time they take from sowing to harvest. Twenty-eight varieties or more accurately speaking lots of seed were grown for the purpose of the primary selection of types. These on examination furnished 161 distinct types. Out of these, 61 were obtained early enough in the year to permit of their being sown again the same year. These 61 types were sown early in September, each on a small plot which was separated from others by a clear space all round. The resulting plants on ripening were examined as to purity. Two of the types having proved impure and one barren were rejected. The remaining 58 types were harvested and their yields calculated, to

100 plants were compared *inter se*. The yields were found to vary within very wide limits as was to be expected. The produce in bulk of each of the 58 little plots as well as the ears of a single plant taken from each were saved. The grain obtained from the single plants was sown in March last and half of the bulk seed of each of the 58 types was sown in June following for further testing of their purity and yields ; but the crops were totally destroyed by the floods. Only the duplicate halves of the " bulk " seed of 57 out of the 58 types which were kept back as a precaution against accidental loss of the stock are all that is left. These will now be sown and if nothing untoward happen, they may yield a definite result after a further course of testing which may take a year or two more.

The remaining one hundred types of early *aus* rice were sown in March last. They too were totally destroyed by the floods.

Transplanted aus.—Twelve varieties of this class were grown in the season of 1914, and furnished in all 79 distinct types of grain. These were sown in the current season for comparison, but shortly after sowing the young plants were overtaken by the flood and wholly destroyed. The work will have to be started anew next season.

Asra.—Nineteen varieties were used and these furnished as many as 125 types of grain last year. These were sown again in the current season, but they too fell a victim to the floods like the rest. A few seedlings may be available for the purpose of making a fresh selection of types. Selections may also be made in such non-experimental *asra* as we may be able to grow this year.

Sail.—This is the most important class of rice in Assam. Seed of 86 varieties of this class was collected from different parts of the Sylhet district and sown last season (1914). These furnished as many as 580 types of grain. The whole of these 580 types had just been sown in seed-beds when the great flood of July came and destroyed them all. As with the *asra* types, a few seedlings may be available of some of these 580 types, and these as well as such non-experimental *sail* rice that may be grown this year will be used as a basis for making a fresh selection of types.

Taking the four classes of rice, there were in all 145 varieties or strictly speaking lots of country seed used in the rice-breeding experiment. These were sown in 1914 and furnished an aggregate of 945 types of grain. All but 57 of these are now lost, making it necessary to make a fresh start from the beginning.

Minor experiments.

6. These included the following—

(1) English Potatoes grown from Shillong seed which is new to the district.

(2) Bonemeal as manure for double-cropped rice land *versus* no manure.

(3) Green manuring with cowpea and *dhanche* (Sesbania aculeata) for rice crop *versus* no manure.

(4) Selection of *aus* rice seed by specific gravity, namely, by dipping the seed in saturated brine and using only those grains which are found to sink.

(5) A variety experiment in jute, three varieties being tested against one another, namely, a pure line bred by Mr. R. S. Finlow, the Fibre Expert of Bengal, a local variety and a variety obtained from the Goalpara district ; and

(6) Jowar as fodder.

Of these, the first was the only experiment in which the crop was harvested during the year under report. In the remaining experiments the crops were on the ground at the close of the year (30th June 1915), and their results will not be available for report for some time yet. It should, however, be mentioned that with the exception of the jute and *dhanche*, all the experimental crops on the ground were destroyed by the excessive rain and floods of May to July last.

The potato experiment was made on one-third of an acre of land. The soil was a clay loam and not quite suitable for potatoes. The crop was planted in the third week of November, the seed rate used being 12 maunds to the acre. The seed which was a mixture of two English varieties, *viz.*, King of potatoes and Magnum-Bonum, was obtained from the Gauhati Seed-Depôt. Owing to great delay in transit much of the seed tubers got spoiled and did not germinate. The crop was manured with cow-dung at the rate of 300 maunds per acre and irrigated twice from a tank. It grew somewhat unevenly and was injured by cut-worms and ground insects which bored into the tubers. The yield amounted to 47¼ maunds to the acre, which was barely a third of what might be expected. It is proposed to repeat the experiment in the current year.

Non-experimental crops.

7. The following were the non-experimental crops grown during the year, inclusive of the numerous varieties of rice which were grown for furnishing types for the rice-breeding experiment. The total yield from each crop is shown along side.

	Approximate area acres.	Yield.
1	2	3
		Mds. srs.
Early *aus* rice	12·8	174 9
Transplanted *aus* rice	2·9	38 27
Asra rice	26·0	336 21
Sail rice	16·0	239 0
Kalai pulse (Phaseolus Roxburghii) ...	4·0	28 10

N. B.—1 maund=40 seers= 82⅔ lbs.

As mentioned in paragraph 4, the winter rice crops (*asra* and *sail*) suffered badly from scanty rainfall in September to November, and the *asra* crop was destroyed on nearly half the area by a disease called *lanka-pura*, which is attributed to the absence of flood water. A considerable part of the *sail* land had to be left uncropped for want of rain at transplanting time.

Broadcast *aus* rice too gave a poor yield. The crop suffered from an excessive growth of weeds which there was no means to keep under check. On account of the heavy spring rain which is experienced in the northern parts of the Sylhet district and which prevents the crop from being weeded and raked as is done all over Bengal, the broadcast varieties of *aus* rice never yield well in the country round Karimganj, though these are grown on a considerable scale for the sake of an early supply of foodgrain.

Receipts and expenditure.

8. The receipts during the year amounted to Rs. 1,706-10-9 derived mostly from the sale of paddy.

The total expenditure was Rs. 20,238-3-2 and was distributed as follows :—

	Rs. a. p.
Establishment	1,691 4 10
Petty construction including fencing roads, bridges and reclamation	12,230 1 0
Demarcation of boundaries	221 4 0
Implements	329 7 0
Purchase of cattle	500 0 0
Feed of cattle	334 3 7
Carried over ...	15,306 4 5

	Rs.	a.	p.
Brought forward ...	15,3 6	4	5
Seed, plants and manures	189	11	0
Wages of labourers	2,612	15	0
Petty repairs	367	3	3
Furniture for office and inspection building ...	504	2	0
Purchase of books	43	12	0
Service postage stamps and telegrams ...	60	0	0
Unspecified charges	1,155	3	6
Total ...	20,238	3	2

Staff.

9. The sanctioned establishment of the farm consists of—

	Rs.
1 Farm Superintendent on ...	100 -10—200
1 Overseer on	80—2—50
1 Farm clerk on	25—1-8—40
and 1 peon	8

Besides, there is sanction for the entertainment of four apprentices annually for a term of two years. These men are to be trained for eventual employment as Demonstrators.

The Farm Superintendent, Babu Rukmini Mohan De, was away on medical leave for six months from the 1st August 1914. He returned to duty on 1st February and remained in charge till the close of the year, when he fell ill again and had to be sent away. During his first illness, his place was taken by Babu Binod Behari Das, the Agricultural Inspector of Sylhet. He is now replaced by the Agricultural Inspector of Karimganj who was till lately the Overseer of the Farm.

The post of Overseer which had been vacant at the close of the previous year was filled up in August last. The incumbent Babu Surendra Nath Gupta, was an *ex*-student of the Nagpur Agricultural College. The main burden of the experimental work fell on his shoulders and he did the work to my complete satisfaction. As a reward for good work, he was promoted towards the close of the year to the rank of Agricultural Inspector, and shortly after, the permanent Superintendent having fallen ill, he was placed in charge of the farm. The post of Overseer has fallen vacant in consequence. It has not yet been filled up.

Babu Nirod Behari Sarma, the Farm clerk, was sent as Government scholar to the Sabour Agricultural College in June

last ; his place has been temporarily filled up by appointing a young Matriculate who like his predecessor is destined to be sent to Sabour a year hence.

At the close of the year there were four apprentices under training on the farm. Two more will be shortly appointed. None of the apprentices has yet completed the full term of practical training.

B. C. BASU,

Special Officer, Agricultural Department, Assam.

Camp Karimganj, The 27th July 1915.

REPORT OF THE KAMRUP SUGARCANE EXPERIMENT STATION FOR THE YEAR ENDING JUNE 30TH, 1915.

Introductory.—The objects and scope of this experiment were sufficiently indicated in paragraph 1 of last year's report* and need no enlargement here. As pointed out therein, the work of last year must be regarded as preliminary to the experiment proper, and briefly consisted in putting down some 23 acres of cane with material brought from Jorhat, to provide planting sets for the first year's experimental work, which was initiated on the arrival of the steam cultivating tackle last cold weather, *viz.*, December 1914. The present report, therefore, deals with the preliminary crop planted in March and April 1914, to provide sufficient planting material, and with the operations appertaining to the first year of the experiment proper covering the preparation of the land and the planting of the cane and its subsequent cultivation up to the end of June 1915.

2. *Land.*—The site of the experiment described in paragraph 2 of last year's report was found during the progress of the rains to be quite unsuitable for cane, as it proved to be relatively somewhat lower than the land lying north of it, in consequence of which water was constantly spilling over it in times of heavy rain. Local drainage work undertaken on the cane area itself proved insufficient in the absence of similar measures on the higher land lying north, which were quite out of the question with the labour then available.

It seems to me quite probable that unless and until very large areas can be simultaneously opened out, and the natural drainage channels cleaned, and wide correlated drainage schemes become possible, trouble from excessive water will be liable to recur. It is further necessary to point out that during the rains the water level is high at present, and local drainage work on a comparatively small area of, say, 100 acres, surrounded as it is on all sides by land under jungle and sometimes at a slightly higher level, apparently fails to reduce the water level very much.

To visit this tract in the cold season is to lead one to believe that most of the land is suitable for cane cultivation.

* Annual Report of the Kamrup Sugarcane Experiment Station, year ending June 30th, 1914.

In the rains, however, it is clearly evident that some of it is constantly in a more or less water-logged condition, and the problem of choosing higher lying tracts is then complicated by the very tall and dense jungle which covers the land, and whose tangled roots hold up the water to a large extent. In view of the unsuitability of the first site referred to above, during August 1914, a new site was chosen lying some two miles due north of the old one. Apparently this was drier, and owing to the presence of the dry bed of an old river lying north, it seemed probable that any water spilling would here be unlikely. Unfortunately this has not turned out to be the case, and owing to the excessive rainfall of the present year spilling from the north has again given trouble, and the cane has suffered in consequence, particularly on the lower lying parts of the area.

For next year's work a drain trencher to be operated by the steam tackle has been ordered, and should go far towards settling the drainage problem. Drainage seems to be undoubtedly of the very essence of the problem of successful cane cultivation in this tract.

3. *Rainfall.*—Records of rainfall have been kept on the farm since January 1st, 1915, and as the following figures to date show, the year has been an excessively wet one :—

	Inches.
January 1915	0·00
February „	2·09
March „	4·68
April „	4·70
May „	21·08
June „	16·81
July „	32·90
August (up to 15th)	15 83
Total to August 15th ...	98·09

We have thus had since May 1st to August 15th, 3½ months, some 86·6 inches of rain, and there is reason to believe this is quite abnormally heavy even for this tract.

4. *Soil.*—The remarks in paragraph 3 of last year's report apply to the soil of the new site. It is only necessary to add that judging by the growth of certain rains and *rabi* crops, *e.g.*, soy beans, cowpeas, dhaincha, jowar, and oats which did very well, the newly broken up soil is very fertile, and is certainly quite free from any toxic factor.

5. *Communications.*—The site is approached from Nalbari station, Eastern Bengal State Railway, by a public road northward to Garbhithar village, some 10 miles, where a village track leading off to Khagrabarigaon has been widened out and made into a carting road, and extended to the present farm site, which is 7 miles from Garbhithar.

6. *Buildings, fencing, etc.*—The change in the site of the experiment necessitated the removal and re-erection of existing *kutcha* buildings, *e.g.*, cattle shed, rest-house, sheds for coolies, godown, etc.

The Public Works Department are building a Chang bungalow for the Manager.

An additional mile of Ideal wire fencing was purchased at a total cost of Rs. 1,145.

7. *Cattle and Implements.*—The 10 pairs of bullocks purchased last year are in first class condition, and are being steadily employed for carting purposes.

8. *Water-supply.*—Norton tube wells have been put down with great success, and an excellent supply of water is obtainable for drinking purposes all the year round.

A permanent stream, running close to the cooly lines, supplies water for washing purposes, engines, etc.

9. *Labour.*—On account of the unsatisfactory character of the local (Kachari) labour, it was found necessary to import coolies from Ranchi. These were recruited by the Manager with the permission of the Government of Bihar and Orissa on the 6 monthly system, and proved most satisfactory. Subsequent recruiting has shown that from now onwards no difficulty will be experienced in getting all the labour required, the Manager on a recent recruiting expedition to Ranchi having had to refuse large numbers of coolies.

10. *Cultivating tackle.*—The steam tackle arrived at Nalbari in September and was erected there by Messrs. John Fowler & Co. who supplied it. It reached the present site at the end of November 1914.

It comprises :—

2 Steam tractors.
1 plough, 5 furrows.
1 Harrow.
1 Cultivator.
1 Roller.
1 Leveller.

The leveller was found necessary for flattening jungle and rough land preliminary to ploughing.

For inter-cultivation, a motor plough was obtained from Messrs. J. Fowler & Co., costing Rs. 3,000, in May 1914, but on account of heavy continuous rain it could not be used during the period under report.

11. *Cane planted April* 1914.—As previously mentioned, 23 acres of cane was planted in the spring of 1914 to provide planting material for an extended area this year. It germinated well over most of the area and made normal growth for a time. With the advent of the rains, for reasons explained in paragraph 2 of this report, and in spite of local drainage measures, the cane received a severe check from which on the lower lying parts it did not properly recover. Those rows of cane which ran parallel and adjacent to the drains were clearly much better than the others, and generally speaking the further the cane was from the drains the worse it became. On the higher land the cane did much better and produce a fair crop.

The final result was disappointing but could not have been otherwise considering the water-logging which occurred in the rains, and the difficulty experienced in getting the water away. The crop was harvested in March and April and proved sufficient to plant some 60 acres this year on the new site.

12. *Preparation of land on new site.*—This was entirely done by the steam cultivating tackle. The " leveller " was first dragged over the land to flatten down the grass jungle and " Kurkani " previous to ploughing.

Ploughing commenced on January 1st, 1915 ; the ground being very rough and all the engine staff new to the work, only some 3 acres per day could be ploughed to a depth of about 1 foot. Subsequently the land was harrowed, then cultivated twice to a depth of 12—15 inches, again harrowed and rolled.

Two blocks of about 62½ acres each and 550 yards square, were prepared in this way. Each block was subdivided by cross roads at right angles into four smaller blocks of approximately 15 acres each.

About 120 acres was thus ready and trenched for planting by the middle of March.

13. *Planting.*—Planting commenced a few days later with material grown the previous year on the old site. About 2 feet was rejected from the bottom of the canes, and the rest of the cane laid end to end in the furrows, and covered 2 to 3 inches deep with soil. Rain for several days in March and April made

the newly made road almost unpassable, and planting was considerably delayed in consequence, as the cane could not be carted up from the old site. Planting was thus not finished till the middle of May.

Admittedly the planting was much too late, but this year, owing to the late arrival of the steam tackle, labour troubles and other causes, it was unavoidable. Some 60 acres of plant cane was put in, together with further 10 acres which was planted with stubbles removed from last year's site.

From the middle of May till the end of the year under report continuous heavy rains seriously interfered with the growth of the cane.

As soon as planting was finished all available labour was put on to draining, but this work was seriously hampered by incessant rain, and before it could be completed, much of the germinated cane on the lower lying parts had been killed out.

Two hand weedings were given up to end of June ; no further cultivation was possible or necessary up to that time.

With the advent of the drain trenching implement, drainage work will as far as possible be completed before next year's cane is planted on the new area now being prepared for that purpose. The cane will be planted much earlier, and by these and other measures it is hoped to be able to avoid many of the evils which have overtaken us this year.

14. *Other crops.*—During 1914 the following crops were grown for trial without manure :—

Rains crops—Cotton.—Buri and Garo Hills varieties.

Ground nuts.—Four varieties :—Raipur, Poona, Big Japan and Verginia.

Green Manure crops.—Cowpeas, Dhaincha and Soybeans.

Rabi crops.—Oats.

Remarks.—The Garo Hills cotton grew to a great height, contrary to its usual habit, but gave the very poor yield of 1 maund 35 seers unginned cotton per acre.

The Buri variety, yielded only 2 maunds 5 seers unginned cotton per acre. Conditions here are apparently too wet for cotton.

The ground nuts unfortunately could not be kept clean on account of shortage of labour, and produced only a small crop.

Cowpeas, Dhaincha and Soybeans all grew very well; the two former produced seed in good quantity; the Soybeans fruited excellently but died off very suddenly from some unknown cause soon after setting its seeds.

The oats grew most luxuriantly, though late sown and produced the good yield of 13½ maunds seed per acre.

Rabi crops, 1915.—Bad weather prevented the sowing of certain crops; the following were sown in June :—

Dhaincha.—Seven acres for seed.

Jowar.—One acre for fodder.

Both crops are doing well.

15. *Expenditure* :—

Heads.	Amount spent up to 31st March 1915.	Amount spent, 1st April to 30th June 1915.	Total.	Remarks.
1	2	3	4	5
I. Establishment—	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Manager ...	6,400 0 0	2,400 0 0	8,800 0 0	
European Ploughman	2,507 0 0	...	2,507 0 0	
Clerk	225 0 0	150 0 0	375 0 0	
Tackle Assistants ...	235 0 0	275 9 9	510 9 9	
Peons	228 0 0	90 0 0	318 0 0	
Total ...	9,595 0 0	2,915 9 9	12,510 9 9	
II. Special Contingencies —				
Steam tackle ...	60,285 0 0	...	60,285 0 0	
Other machinery and implements.	5,185 8 0	50 0 0	5,235 8 0	Motor plough leveller and tools.
Fencing ...	...	1,145 2 0	1,145 2 0	
Total ...	65,470 8 0	1,195 2 0	66,665 10 0	

Heads.	Amount spent up to 31st March 1915.	Amount spent, 1st April to 30th June 1915.	Total.	Remarks.
1	2	3	4	5
III. Regular contingencies—	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Feed of cattle ...	485 13 0	0 14 0	486 11 0	-
Seeds and manures, etc.	1,828 8 0	268 8 3	2,097 0 3	Cake 780 maunds in hand value, Rs. 1,890 at site, July 1st, 1915.
Wages of labourers ...	4,124 7 6	1,829 2 3	5,953 9 9	
Petty repairs ...	149 7 0	5 0 0	154 7 0	-
Service postage ...	59 12 10	...	59 12 10	
Fuel	2,692 0 11	1,566 11 9	4,258 12 8	About 130 tons in stock, July 1st, 1915.
Stores, oil, etc. ...	350 0 0	13 12 0	363 12 0	
Cost of getting machinery to site.	760 0 0	...	760 0 0	
Miscellaneous ...	720 2 0	133 10 6	853 12 6	
Total ...	11,170 3 3	3,817 10 9	14,987 14 0	

Petty construction.—Transferred to Public Works Department accounts. The following amounts were disbursed from budget, 1914-15 :—

	Rs.	a.	p.
Buildings	2,349	3	9
Roads	3,982	8	0
Total ...	6,331	11	9

In addition a sum of Rs. 309 has been spent on roads from the budget for 1915-16, *i.e.*, since April 1st, 1915.

16. *Staff.*—The present staff consists of :—

		Rs.
Manager on		800
Clerk on		50
6 Engine men {	4 on	18
	2 on	15
3 peons on		10

Government sanction was obtained for a head ploughman on Rs. 110, but this post has not been filled as yet.

The Deputy Director of Agriculture (Mr. Birt) inspected the farm several times during the year until May 1915, when he obtained a commission in the Indian Army Reserve of Officers.

The Manager, Mr. C. S. Chaston, took over his duties as from 1st July 1914 and resides on the farm. The general health has been very good.

A. A. MEGGITT,

Acting Deputy Director of Agriculture, Assam.

Kamrup Farm,
The 18th August 1915.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE ASSAM VALLEY DURING THE YEAR ENDING THE 30TH JUNE 1915.

Maulvi Fazlal Haq Ahmed, Agricultural Supervisor, was in charge, assisted by the District Agricultural Officer and one demonstrator in Kamrup, and by three demonstrators in Sibsagar.

2. The following demonstrations were undertaken during the year:—

Paddy	...	(*a*) Manuring with Bonemeal and Flour Phosphate.
		(*b*) Green-manuring for paddy.
Sugarcane	...	(*a*) Superior varieties of cane.
		(*b*) Green-manuring for cane.
		(*c*) Three roller iron crushing mills.
Potatoes	...	Superior varieties.
Fodder crops—		
Meston Ploughs	...	Use of.
Conservation of cattle manure.		Improved methods for.

3. *Manuring with Bonemeal and Flour Phosphate.*—Seven centres in Kamrup and 10 in Sibsagar manured with bonemeal and flour phosphate in 1913, were kept under observation for residual effect, no further manure being used. The first year's results appeared in last year's report.

Paddy.

The 2nd year's results are shown in the following tables; in the case of the Kamrup demonstrations results for only 5 out of the 7 centres are available, as in the other 2 cases the paddy was accidentally mixed up at harvest time.

Sibsagar District.

No.	Locality.	Grain per acre in lbs.			Remarks.
		Bonemeal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6
1	Lakwa	...	435	324	Planted too late.
2	Sibsagar	1,710	1,894	1,508	
3	Nazira	1,692	2,040	1,210	
4	Chikonidhora (Jorhat) ...	1,456	818	750	
5	Kakajan („) ...	60	152	37	Planted very late.
6	Cherenjia („) ...	1,057	977	768	
7	Kacharihat (Golaghat) ...	258	264	260	
8	Titabar	982	1,226	890	
9	Jhanzi	1,668	2,188	1,287	
10	Dergaon	516	430	383	

The average increase in yield of the bonemeal and flour phosphate plots over the untreated plots, was almost identical in this, the second year of the experiment, *viz.*, 300 lbs. paddy grain per acre, valued at Rs. 10-15, at ruling prices. For the first two years of this demonstration, this in the case of the flour phosphate gives a gross average profit of Rs. 19-3 per acre, and for the bonemeal a profit of Rs. 9-7 per acre.

Kamrup District.

No.	Locality.	Grain per acre in lbs.			Remarks.
		Bone meal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6
1	Nalbari ...	1,728 (*Aus*)	1,449 (*Aus*)	968 (*Aus*)	
2	Chaygaon ...	1,606 („)	1,437 („)	1,397 („)	
		3,239 (*Sali*)	3,549 (*Sali*)	2,750 (*Sali*)	
3	Deshpur ...	1,453 („)	935 („)	1,076 („)	
4	Kamalpur ...	2,025 („)	1,762 („)	1,347 („)	
5	Chakchaka ...	2,314 („)	2,033 („)	1,816 („)	

As mentioned in last year's report, in the case of these Kamrup demonstrations, the results were quite unreliable in the first year on account of severe floods, and were consequently not published. How far this has affected these the 2nd year's results one cannot say. The figures are given as obtained.

On analysis, the bonemeal and flour phosphate plots show an average increase over the untreated plots of 603 lbs. (value Rs. 18) and 363 lbs. (value Rs. 10-12) paddy grain, per acre, respectively.

The value of the bonemeal applied was Rs. 9 per acre, and of the flour phosphate Rs. 7-8 per acre. The net profit therefore in the second year from the use of bonemeal is Rs. 9 per acre, and in the case of the flour phosphate Rs. 3-4.

The outturn of all the above plots is being recorded for the third year also. It will be seen that while in the Sibsagar district flour phosphate so far gives better results than bonemeal and at a less cost per acre, this is reversed in Kamrup, where conditions are different.

4. *New demonstration work on paddy.*—During 1914, 12 new centres in Sibsagar and 10 in Kamrup were started as bonemeal demonstrations. At each centre one plot was

manured with bonemeal at the rate of 3 maunds per acre, the other plot being untreated. The results are given in the following tables :—

Sibsagar District.

No.	Locality.	Grain in lbs. per acre.		Remarks.
		Bonemeal plots.	Untreated plots.	
1	2	3	4	5
1	Kanogaon	1,740	1,034	
2	Barkathanee	836	762	
3	Nahoranee	708	610	
4	Kamargaon	1,100	1,076	
5	Charaibahi	1,242	344	
6	Pokamura	812	268	
7	Hatigarh	1,200	710	
8	Nakachari	1,242	824	
9	Bogidol	957	785	
10	Namtiali	1,818	1,724	
11	Amguri	954	693	
12	Suffrai	960	775	

These plots show an average increase due to the use of bone meal of 330 lbs. per acre, valued at Rs. 12. Cost of bonemeal was Rs. 9 per acre, hence the first year of the demonstration shows an all round profit of Rs. 3 per acre; any increase in the 2nd and 3rd years will be pure profit.

Kamrup District.

No.	Locality	Grain in lbs. per acre.				Remarks.
		Bonemeal plots.		Untreated plots.		
		Aus paddy.	*Sali* paddy.	*Aus* paddy.	*Sali* paddy.	
1	2	3	4	5	6	7
1	Rangia ...	1,736	...	1,362	...	
2	Septi ...	1,312	...	1,150	...	
3	Digaru ...	...	1,972	...	1,800	
4	Bang ...	...	1,520	...	1,366	
5	Cheukhuti ...	...	998	...	808	
6	Parakuchi ...	1,114	...	805	...	
7	Ajra ...	...	2,162	...	1,976	
8	Bilpar ...	...	2,270	...	2,132	

These results shew an average increase per acre from the bonemeal plots of 282 lbs. in the case of *aus* paddy, valued Rs. 8-13, and of 150 lbs. per acre in the case of *sali* paddy, valued at Rs. 4-12. Some of these Kamrup soils are apparently not in great need of phosphatic-manuring, nevertheless it seems certain that taken over the 3 years for which the bonemeal may be expected to act, a good net profit per acre will accrue.

Srijut Narayan Barua, Honorary Correspondent, Nakachari, continued his paddy demonstrations mentioned in last year's report, under the guidance of the Agricultural Supervisor. In one plot manured with 3 maunds per acre bonemeal he obtained 1,353 lbs. of paddy per acre, as against 1,275 lbs. with flour phosphate, and 1,230 lbs. per acre on an untreated plot.

In another demonstration he obtained 3,228 lbs. paddy per acre by transplanting 2 seedlings in a bunch 15 inches apart, 3,144 lbs. by transplanting 3 seedlings in a bunch 15 inches apart, and 2,070 lbs. by transplanting 6 to 10 seedlings in a bunch

in the ordinary local manner. These results confirm those of last year and emphasize the value of planting a smaller number of seedlings than is customary.

Srijut Pithambar Saikia, Honorary Correspondent, also did a paddy demonstration, using bonemeal *versus* cowdung *versus* no manure.

The cowdung plot gave 2,232 lbs. paddy per acre, the bonemeal 2,115 lbs. and the untreated plot 1,812 lbs. The residual effect of these manures is being observed this year.

5. *Green manuring for paddy.—Dhaincha* was grown and ploughed in this year as preparation for paddy at a few centres. The results will be recorded in next year's report, as the crop is only now on the ground.

Varieties.

6. *Sugarcane.*—No fresh demonstrations of superior varieties of cane were commenced in 1914, as the whole of the planting material available was sent to the Kamrup farm for the initiation of the cane work there.

At several centres in Sibsagar and Kamrup new demonstrations were commenced in the spring of 1915; the results will be recorded in next year's report, after harvest. At each centre planting and manuring was done in the local way, and in every case a check plot of the variety of cane locally grown is included for comparison. These are purely variety tests under the local conditions obtaining.

That our improved varieties of cane are appreciated, and are fast appealing to the cultivators' fancy, admits of no doubt.

Year by year the demand for sets increases; this year some 26,000 sets were either sold, or distributed free for demonstration purposes from the Jorhat Farm, while the Manager of the Mowkhuli Sugar Farm at Tinsukia kindly supplied a further 40,000 sets of our improved varieties on easy terms to cultivators at our request. These varieties were introduced into Kamrup this year, where 10,000 sets were distributed free for demonstration.

In all, some 70,000 sets have thus been distributed this year in the Assam Valley alone.

Srijut Thaneswar Sarma Barthakur of Mohakuti, Sibsagar, obtained cuttings of Barbadoes 147 cane last year from the Jorhat Farm, and grew them alongside the local cane, and as shewn in last year's report the net profit per acre from the B 147 was Rs. 151 as against Rs. 23 for the local variety.

This year a ratoon crop was taken and a careful account of cost of cultivation and outturn of each plot was again kept, with the following most satisfactory results :—

	B 147.	Local variety.
	Rs. a. p.	Rs. a. p.
Total expenditure including cost of cultivation, manuring, crushing and *gur*-making, etc.	112 3 0	79 3 6
	lbs.	lbs.
Outturn—		
Weight of cane	42,230	20,254
„ of juice	26,096	9,368
„ of gur	5,442	1,608
	Rs. a. p.	Rs. a. p.
Price actually realised for *gur*	408 4 9	117 9 3
Profit per acre ...	296 1 9	38 5 9

It is only fair to state that a part of the plot of the local cane was damaged by wild elephants. This largely discounts the value of the figures. Taking a liberal estimate of the damage however, and reckoning the value of the *gur* obtained from the local cane at double the figure stated, *i.e*, Rs. 234, the net profit would still only be Rs. 155 per acre as against double that figure for the Barbadoes cane.

Green manuring for cane.—At one centre in Kamrup and another at Sibsagar, in 1914 *Dhaincha* and cowpeas were grown, respectively, as green manure in preparation for cane, which was planted in the spring of 1915. The results will be available next year.

A few more centres in each district are being green manured this year, for planting with cane next.

Iron crushing mills.—Demonstrations with three roller iron bullock power crushing mills were continued in both districts. These mills are rapidly rising in public appreciation.

In the Sibsagar district 4 mills were sold, and 3 were hired out at 4 annas per day for the whole crushing season. Many more could have been hired out, but were not available. In addition, 9 mills were sent out for demonstration purposes in the district. In Kamrup, these mills were demonstrated at Sorbhag, North Gauhati, Cheukhuti, Dharmapur, Palasbari and Ajra. As a result 13 mills were sold during the year. Two Co-operative Societies purchased 3 mills. Villagers near Nalbari propose to

combine to purchase a mill. In this way it is hoped that each village will possess at least one mill in the near future. The Agricultural Department sells these mills on a strictly cash basis at Rs. 65 each. There would appear to be a great opening for Co-operative Credit Societies here.

7. *Potatoes.*—Demonstrations of superior varieties were made in both districts, Sibsagar and Kamrup.

In some cases these demonstrations were completely ruined, and in others more or less so, owing to the fact that the improved varieties sent from Shillong were held up a considerable time by the Motor Transport Co., and were found to be very much damaged and diseased on arrival at Gauhati; most were unfit for seed purposes.

The demonstrations in the Sibsagar district were a failure in consequence, and no results are recorded.

In Kamrup the results were better, and the figures for 6 centres out of 10 are given below. In the case of the other 4 centres, the demonstrations failed owing to bad germination.

The superior varieties of potato used were "Magnum Bonum" and "King of Potatoes"; at each centre, these were grown against local bazar seed which was in most cases a mixture of Khasi acclimatised types apparently.

Kamrup District.

No.	Locality.	Varieties planted.	Yield per acre.	Value of increase at Rs. 2-8-0 per maund.	Remarks.
1	2	3	4	5	6
			Mds. srs.	Rs.	
1	Bhalipara ...	Magnum Bonum ...	120 20	235	
		Small *Deshi* variety ...	26 5		
	Garigaon ...	Magnum Bonum ...	69 17	56	
		Deshi variety ...	46 30		

Kamrup District—concluded.

No.	Locality.	Variety planted.	Yield per acre.	Value of increase at Rs. 2-8-0 per maund.	Remarks.
1	2	3	4	5	6
			Mds. srs.	Rs.	
3	Hadilapur ...	King of Potato and Magnum Bonum.	79 34	23	
		Bazar mixed variety ...	70 16		
4	Hadilap ...	King of Potato and Magnum Bonum.	123 6	138	
		Bazar mixed variety ...	67 37		
5	Palasbari ...	King of Potato and Magnum Bonum.	89 27	55	
		Bazar mixed variety ...	67 22		
6	Dharapur ...	King of Potato and Magnum Bonum.	105 8	10	
		Bazar mixed variety ...	101 0		

It will be seen that despite the damage to the seed potatoes referred to above, in all these cases the improved varieties return a higher yield than the bazar seed, the value of the increase in some cases being very considerable.

Potato cultivation was also demonstrated at four other centres, using our superior varieties ; no comparison with local seed was made as the cultivation of this crop was new to these particular places.

8. *Fodder crops.*—Jowar was grown as a fodder crop in two centres in the Kamrup district. It made good growth ; unfortunately no records of weight were made.

This work is being extended.

9. *Meston ploughs, use of.*—Six Meston ploughs were sent out in both districts Sibsagar and Kamrup, for demonstration in the villages. The demonstrators showed the cultivators how to use them, and many cultivators tried the ploughs themselves.

As a result 5 ploughs were sold in Kamrup and 2 in Lakhimpur. Great interest was aroused in these ploughs, and a rapid extension in their use may be expected as they are cheap, light and relatively efficient.

Srijut Rajani Kanta Choudhury and Srijut Pithambar Saikia, mauzadars of Sarbhog and Khawang, respectively, were so convinced of the usefulness of the Meston plough that they are regularly using them on their holdings, and their example should do much towards a general extension in their use.

10. *Conservation of cattle manure.*—Model manure pits, covered in, have been erected in both the Sibsagar and Kamrup districts, under the supervision of the demonstrators. Villages in which other demonstrations are going on, are chosen as centres for at least one model pit each.

In all some 30 such pits have been constructed to date, and the villagers have been instructed as to their proper use.

A. A. MEGGITT,

Shillong,
The 27th August 1915. } *Acting Deputy Director of Agriculture, Assam.*

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE KHASI AND JAINTIA HILLS DISTRICT DURING THE YEAR ENDING THE 30TH JUNE 1915.

U Harry Singh, Agricultural Inspector, Khasi and Jaintia Hills, was in charge of this work, assisted by three demonstrators headquartered at Shillong, Mawphlang and Jowai, respectively.

Rice.

2. Demonstration work, as to the value of bonemeal for paddy, underwent a considerable extension during the year.

New Demonstrations.

New work was undertaken in 10 centres, five in the Khasi and five in the Jaintia Hills. At each of these centres two plots, each ⅓rd acre were taken, one was manured with bonemeal 3 maunds (246 lbs.) per acre, the other being untreated as a check.

The first year's results are given in the following table:—

No.	Place.	Cultivator.	Yield of grain in lbs. per acre.		Remarks.
			Bonemeal plots.	Untreated plots.	
1	2	3	4	5	6
1	Laubyrtun ...	Suha Myntri ...	810	63	Destroyed by insects.
2	Nongkasen ...	Rang Singh ...	1,545	528	
3	Pariong ...	Rison Singh ...	906	216	Destroyed by insects.
4	Nongsynrih ...	Kpa U Ro ...	978	1,032	Ditt
5	Jakrem ...	Konrai ...	1,710	498	
6	Raliang ...	Khmah Spadep ...	1,740	984	
7	Nongbah ...	Khmied pasie ...	1,230	480	Damaged by floods.
8	Nongjngi ...	Hed Doloi ...	1,620	1,668	Damaged by insects.
9	Wahjajer ...	Ket phama ...	1,284	4	
10	Nartiang ...	U Kat ...	1,176	1,110	

At five centres Nos. 1, 3, 4, 7 and 8, the demonstrations were spoilt either by insect attack or by flood. In some of these cases the bonemeal plots were the chief sufferers, in others the untreated plots. They must therefore be neglected. Leaving them out of account, the average yield per acre of the bonemeal plots works out at 1,491 lbs. against 734 lbs. for the untreated plots.

Thus the average increase over the untreated plots due to bonemeal is 757 lbs. of grain per acre. Valuing the bonemeal at Rs. 5 at Shillong, and the paddy grain at Rs. 3 per maund, the bonemeal plots shew a gross profit of Rs. 27-12 on an expenditure of Rs. 15, leaving a net profit of Rs. 12-12 per acre. These plots are being kept under observation as to the second and third year results of the initial dressing of bonemeal.

A trial of Egyptian raw phosphate against bonemeal and against no manure was also made at Bannium. Three plots each ⅓rd acre were taken, one received 3 maunds bonemeal per acre, another 3 maunds Egyptian phosphate per acre, and the third nil. All these plots were more or less damaged by insect pests, and the yields are small in consequence. They are given here merely for record, against the receipt of the second and third year results in due course.

The bonemeal plot gave 720 lbs., the Egyptian phosphate 510 lbs. and the untreated plot only 360 lbs. paddy grain per acre.

Second year demonstrations.—The demonstrations (10 centres) commenced in 1913, of which the first year's results appeared in last year's report were kept under observation this year, without any further manuring, and the 2nd year's results are now forthcoming and appear in the table below:—

No.	Place.	Cultivator.	Yield of grain in lbs. per acre.			Remarks.
			Bone-meal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6	7
1	Smit	Raja Dakhor Singh (Siem of Khyrim).	348	208	354	Most of these demonstrations were damaged by insect attack, hence the low yields. throughout the district much damage to the rice crop was caused by insect pests.
2	Umlyngka ...	Kpa ka Kwai ...	1,302	1,092	597	
3	Mairang	Kmi ka Selina ...	912	870	795	
4	Kynshi	Ka Man	597	576	536	
5	Khiem Mawrah ...	Kpa U Rubin ...	840	840	602(a)	
6	Mylliem ...	U Hira Shon ...	360	360	376(b)	
7	Shangpung ...	U Simon Dkhar ...	918	840	564(a)	
8	Sutnga	U Lakon Banon ...	720	552	132(b)	
9	Jowai	U Tamon Nikhla ...	1,296	996	976	
10	Mawlyngkneng ...	Ka Sngit Lawai ...	1,733	1,219	982(b)	

(a) Average of two plots.
(b) Average of th ee plots.

The figures for yield are very much down on last year's outturn due to ravages by insect pests, which were uncommonly numerous this year. Nevertheless, taking the average of the 10 centres, the average increase over the untreated plots due to bonemeal is 232 lbs., and that due to flour phosphate 114 lbs. of grain per acre.

Valuing the grain at Rs. 3 per maund, the average profit per acre in this the second year, is Rs. 9-12 for bonemeal and Rs. 4-4 for the flour phosphate. The total net profit per acre for the first 2 years of these demonstrations averages out at Rs. 26-4 in the case of the bonemeal plots, and Rs. 13-4 for the flour phosphate plots.

The outturn of these plots is being recorded for the third year also.

As will have been noticed, the demonstration work this year has been more or less spoilt by ravages of insect pests. The incidence of attack throughout the district was much greater than usual. Early in the year a small bug, the 'Rice fulgorid' appeared in large numbers throughout the district. This was investigated, and information in regard to suitable treatment was received, but rather late to be of much use. Demonstrations of a method for combating this disease were at once made in eight centres and were successful.

The demonstrators were subsequently put on special duty in their circles, spreading a knowledge of the method for checking this pest.

3. *Bone crushing operations, bonemeal distribution.*—The practice of manuring with bonemeal is steadily increasing among the hill cultivators, and the demand is becoming keen.

Up to now the high price in the hills has tended to limit its use, the bonemeal having to be brought up from Calcutta.

A small bone grinding installation was put up at the Upper Shillong Farm, and crushing operations commenced in February 1915. Some 356 maunds of bones, collected in the hills, were crushed during the next few months, yielding 305 maunds bonemeal. This was sold at Rs. 3-8 per maund at Shillong as against Rs. 5-2-6 charged last year for Calcutta bonemeal. As a consequence some 301½ maunds were sold this year, as against only 141 maunds last year. This is a very satisfactory increase.

During the year new depôts for the sale of bonemeal were opened in 3 centres. The quantities sold at these depôts were a follows:— s

				Rs.	a.	p.
Shillong Farm.	123½ maunds	...	at	3	8	0
Marbisu	31 „	...	„	3	10	0
Jowai	114 „ new stook	...	„	4	12	0
	33 „ old Calcutta stock		„	5	2	6

4. *Potatoes.*—Public appreciation of the value of the imported varieties of potatoes grown at the Upper Shillong Farm continues to increase. To meet the demand, and provide facilities for easy supply of seed, depôts were opened at nine centres eight of which are in the potato-growing tracts, *viz* :—

1. Upper Shillong Farm.
2. Mawkhar.
3. Mawphlang.
4. Dumpep.
5. Laitlyngkot.
6. Ladmawphlang.
7. Marbisu.
8. Cherrapunji.
9. Jowai.

The price of "seed" at the Farm was Rs. 2-2 per maund that being the average market rate in Shillong last season, the price at depôts being Rs. 2-2 plus cost of freight from Farm. The total quantity sold was 678 maunds of which 395 maunds were issued from the Farm and 283 maunds from the other depôts. King of Potatoes and Magnum Bonum made up the bulk of the potatoes sold.

At the annual agricultural show an innovation consisted in the distribution of 10 maunds King of Potatoes to prize winners in certain classes in addition to prize money.

Two demonstrations undertaken by the Department in tracts, where potatoes are not generally grown proved unsuccessful owing to a prolonged drought in the spring ; this is unfortunate, but our efforts to popularise potato cultivation in these tracts will be persisted in. Conditions cannot always be unfavourable. At one of these centres a winter crop will be taken next cold weather under the supervision of a demonstrator.

Our efforts to popularise the spraying of potatoes with Bordeaux mixture, by sending out trained men to spray cultivators' crops at cost price, were continued. Unfortunately the majority of the cultivators were unwilling to bear the cost of spraying crops which to all appearance were already doomed to failure, more or less complete, owing to unfavourable weather conditions. However some 12 acres were sprayed this year as against 9 in the previous season. One spraying machine was sold during the year to a cultivator on the Cherrapunji side.

5. *Grafting of fruit trees.*—Demonstrations in grafting were made as usual in the villages by the demonstrators while on tour. The following grafts were made in 32 villages :—

Oranges	316	(budding).
Pears	127	in hill stations.
Apples	44	
Peaches	61	
Plums	61	
Apricots	44	
Total	653	

All the oranges were budded on old limes and wild citrus stocks, with the object, as mentioned in previous reports, of avoiding the disease which has threatened to wipe out the orange industry. Up to date no signs of disease are apparent on any of the oranges so budded, and one tree budded four years go is now carrying its second crop of oranges.

For want of citrus nurseries this work cannot be pushed as one would wish. he majority of orange-growers do not yet appreciate the value of this work, only time can bring home to them its advantages. However two cultivators have this year shown the way to others, by planting out citrus nurseries with the seed of the local pomelo. The young pomelo stocks will be used later for orange budding.

This promises to be an extremely useful line of work.

6. *Supply of seeds and plants.*—The following seeds and plants were distributed during the year outside the district:—

Orange seeds	2 lbs.
Orange seedlings	2,541
Lime „	6
Tezpat „	50
Ceylon Pineapple	12 crowns.

7. *Pan disease—work on.*—As mentioned in previous reports, work, having for its object the elimination of this disease, has been going on for the past few years. Spraying plants, already affected with the disease, with Bordeaux mixture was adversely reported on last year, while the removal and burning of all diseased plants and the spraying with Bordeaux mixture of all healthy ones, was advocated as a promising method of attack.

During this year, specimens of diseased plants were sent to the Imperial Mycologist, Pusa, who made an investigation of them.

Arrangements have been made with the owners of one garden quite free from the disease, and two disease affected gardens, for such experimental work as the Imperial Mycologist may devise as a result of his preliminary examinations of diseased material. An assistant from Pusa actually commenced operations last January, without much success however. It is proposed to try again in the rains when the desease is most apparent; during the cold whether it is more or less in abeyance.

8 *Terrace Cultivation.*—This work, fully described in paragraph 6 of last year's report, at Mawlat village, was abandoned in the autumn of 1914, as being likely to lead to no useful results.

A proposal is on foot for some new work on terrace cultivation at Damalgiri in the Garo Hills, in view of which a demonstrator was posted there in July 1914. It has not been possible to comence this work up to date. The demonstrator in the meantime is touring in order to become acquainted with local conditions and cultivation, and supervising a small terracing experiment undertaken by the Deputy Commissioner at Tura besides initiating other demonstration work in the vicinity.

A. A. MEGGITT,

Acting Deputy Director of Agriculture, Assam.

Dated Shillong,

The 2nd September 1915.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE SURMA VALLEY DURING THE YEAR ENDING THE 30TH JUNE 1915.

General.

The demonstration work in the Surma Valley made but little progress during the year. The Agricultural Inspector, Babu Binod Behari Das, was the only officer available for organising and supervising such work, and he too was able to give very little of his time to this work during six months—1st August to 31st January—when he had to act for the Farm Superintendent of Karimganj. These six months covered the most important part of the year for demonstration work. The Agricultural Inspector has not yet got a single fieldman to assist him in field work. In these circumstances, very few demonstrations could be organized and the few that were taken in hand received but nominal supervision from the Agricultural Inspector. The cultivators or Honorary Correspondents on whose land the demonstrations were made were practically left to manage them as best they could. Demonstration work done under such condition can seldom yield a satisfactory result. A second Agricultural Inspector for the Surma Valley was appointed towards the close of the year, but he had barely commenced his duties when the Superintendent of the Karimganj Farm having fallen ill, he was asked to take charge of the farm. His services may not be available for demonstration work for some months yet.

The Surma Valley has also recently been provided with an Agricultural Supervisor in the person of Mr. Lakheswar Barthakur. He joined his duties on the 29th June. The agricultural conditions of the Surma Valley being new to him, he has been directed to make a preliminary study of the local system of agriculture before taking part in demonstration work.

Kinds of demonstrations made.

2. The demonstrations made during the year were of two kinds. The first kind was intended to show the value of bonemeal and flour phosphate as manures for the rice crop. Several demonstrations of this kind had been started in the previous year. Those made during the year under report were either in continuation of those

of the previous year or were new ones organised during the year. These manure demonstrations partake to a large extent of the nature of experiments, since we cannot be sure that bonemeal or flour phosphate will pay on any given soil until it has been actually tested and found to be profitable.

The second kind of demonstrations had for their object the introduction to the notice of local potato growers the superior merits of English seed imported from the Khasi Hills compared with the local kinds. The English varieties are more productive and command better prices than the local ones, though in respect of keeping quality and the quantity and cost of seed tubers required for planting the latter possess decided advantages over the former.

Bonemeal and flour-phosphate as manures for rice land.

3. It will be seen from my last Annual Report that the majority of the bonemeal and flour phosphate demonstrations made in the year 1913-14 were destroyed by the high flood which occurred in July. In only five places the flood was not severe enough to destroy the crop or to cover the land with a thick deposit of silt. The use of bonemeal and flour phosphate in the demonstrations at those five places was attended with results which were more or less satisfactory.

These manures dissolve slowly in the soil and continue to show their influence for several years after they are applied. It was decided, therefore, to keep under observation the demonstration plots at the five places mentioned above in order to note what effects the manures would produce in the second year. One of these demonstrations came to nought, because the cultivator, though asked, did not take the trouble of weighing the yields of the manured and

unmanured plots; and another became useless on account of the crop being destroyed by insects. The remaining three demonstrations gave very definite results, as shown in the following statements :—

Locality.	Manure used per acre. A.—Bonemeal 3 maunds. B.—Flour-phosphate 3 maunds. C.—No manure.	1914-15, per acre.				1913-14 per acre.	1913-15, per acre (in two years).				Remarks.
		Aus rice outturn.	Sail rice outturn.	Total outturn.	Increase in two crops.	Increase in two crops.	Total increase per acre.	Value of total increase.	Cost of manure.	Money gain.	
1	2	3	4	5	6	7	8	9	10	11	12
		Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Chunghar	A	8 23	8 23	17 6	4 28	6 19	11 7	27 15 0	9 0 0	18 15 0	Want of rain in the latter part of the season was responsible for short yield of *sail* rice at Chunghar and Barlekha. At Bhanga two of the plots bore only *aus* rice and two other only the *sail* crop.
	B	8 38	5 2	14 0	1 22	1 22	3 4	7 12 0	7 8 0	0 4 0	
	C	8 9	4 18	12 18	...	...	...	...	...	...	
Barlekha	A	8 14	12 19	20 33	6 29	5 3	11 32	29 7 9	9 0 0	20 7 9	
	B	6 5	9 30	15 35	1 31	5 39	7 30	19 5 6	7 8 0	11 13 6	
	C	5 30	8 14	14 4	...	...	...	...	...	...	
Bhanga	A	...	15 14	15 14	2 11	5 11	7 22	18 14 6	9 0 0	9 14 6	
	C	...	13 3	13 3	...	...	...	...	...	...	
.....	B	16 31	...	16 31	5 2	3 39	9 1	22 9 3	7 8 0	15 1 3	
	C	11 29	...	11 29	...	...	...	...	...	...	

It will be seen that the use of bonemeal left a handsome profit at the end of two years. Flour-phosphate too gave a satisfactory net profit in two out of the three demonstrations ; in the third its cost was just recovered. It is expected that the manures will show their beneficial effect for a year or two longer.

Only four new demonstrations with these manures could be organized during the year. All the four demonstrations were made on land belonging to our Honorary Correspondents and under their supervision. In case of two of these demonstrations, the result furnished by the Honorary Correspondents in charge appeared extremely untrustworthy and were, therefore, rejected. At Jabainpur in the Karimganj subdivision where one of the remaining two demonstrations was made, the application of 3 maunds of bonemeal gave a net increase in yield (taking the two crops of *aus* and *sail* together, of 10 maunds 36 seers of paddy valued at Rs. 27-4-0, and after deducting the cost of the manure (Rs. 9), it left a net profit of Rs. 18-4-0, to the acre. In the same demonstrations the use of flour-phosphate at 3 maunds costing Rs. 7-8-0 per acre caused an increase in yield of 5 maunds 27 seers of grain and a net profit of Rs. 6-10-9. The owner of the land is reported to be well pleased with these results.

In the fourth demonstration which was made at Sultanpur in the North Sylhet subdivision, bonemeal alone was tried, and for want of timely cultivation, only one crop of rice, namely *sail*, could be taken. For want of rain the outturn of this crop was very poor, and the full influence of the bonemeal could not be brought out. The manure increased the yield by 2 maunds 15 seers only per acre, valued at Rs. 5-14-0 which was not enough to cover its cost.

The plots of land used in these two demonstrations are being kept under observation in the current year.

Eleven new demonstrations with manures for rice land have been laid out in the current year. Our staff being very limited, it was decided to concentrate these demonstrations as far as possible within a small tract of country. The locality selected is a comparatively high lying, red soil tract lying between Barlekha and Dakshinbhag in the Karimganj subdivision. The laterite soil of this tract is likely to respond well to the action of a phosphatic manure like bonemeal. The results of these demonstrations will not be known for some months yet.

Potato demonstrations.

4. Thirty-two demonstrations were made with English potatoes during the year under report. Twelve of these were made under the personal care of Honorary Correspondents of this Department. The remaining demonstrations were made in the fields of selected

cultivators. For reasons already stated, the demonstrations had to be left practically without supervision.

Each Honorary Correspondent and cultivator who agreed to have a demonstration made on his land was supplied with one to two maunds of seed potatoes free of charge. The total quantity of seed supplied was 45 maunds.

The seed was the produce of the Upper Shillong Farm and was obtained through the Departmental Seed-Depôt at Gauhati. There was great delay in transit on account of which the seed potatoes did not reach the cultivators' hands until the season for planting had almost passed. Much of the seed was lost through rotting in consequence of the long time it remained in the bags and in railway godowns. Only the sounder tubers were used for planting, but these also had suffered from heating during transit and did not therefore germinate as well as they should have done.

The seed not having arrived in time, it happened in several cases that the land which had been intended for planting it was used for some other crop, and the potato seed, when it came, had to be put down in a new piece of land hastily prepared for the purpose. Late planting was also responsible for more or less damage by insects which happened to most of the demonstration crops.

Satisfactory results could hardly be expected under these conditions. In twelve out of the 32 demonstrations, the crop failed altogether ; in five the yield was less than 3 times the quantity of seed used, in eight it was between 3 and 5 fold, in four between 5 and 7 fold and in three, it reached the respectable figure of 9 to 10 times the seed planted.

The demonstrations were far from convincing but many of those who grew the English potatoes did not fail to notice that they were more vigorous and more prolific, plant for plant, than the native kinds. I visited some of the demonstrations and questioned the people about them. I noticed a wide-spread desire among them to give the English varieties a further trial.

The plan which we followed last year of selecting a number of cultivators in different parts of the district and giving them free of cost a quantity of seed potatoes for trial in their fields did not seem to me to be quite a sound one especially when the seed was of a kind which could be readily used for eating or even for sale. There was cause for suspecting that such use had been made. Moreover, it has been found impossible with our very small staff to keep an eye on a large number of demonstrations scattered over a whole district.

It has been decided, therefore, that no free distribution of seed potatoes should be made in the ensuing year. But two or three temporary depôts for the sale of seed at cost price to cultivators will be opened in those parts of the district where potatoes have already become a staple crop. It remains to be seen whether the new procedure will answer its purpose.

B. C. BASU,

Camp KARIMGANJ;
The 28th July 1915.

Special Officer, Agricultural Department, Assam.

A. S. P. O. (D. L. R. & A.) No. 71-510-18-12-1915-A. E. R.

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